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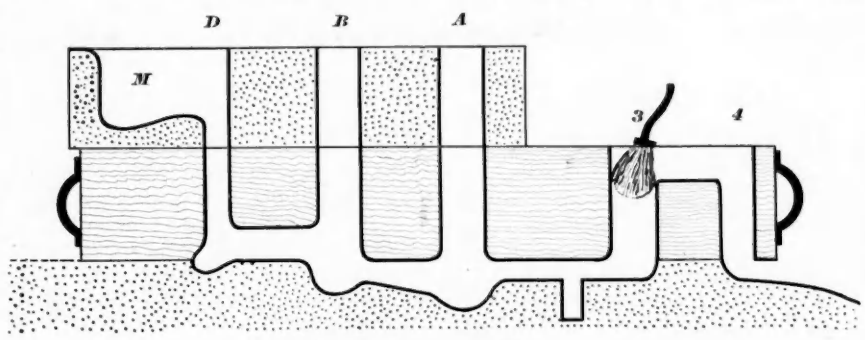
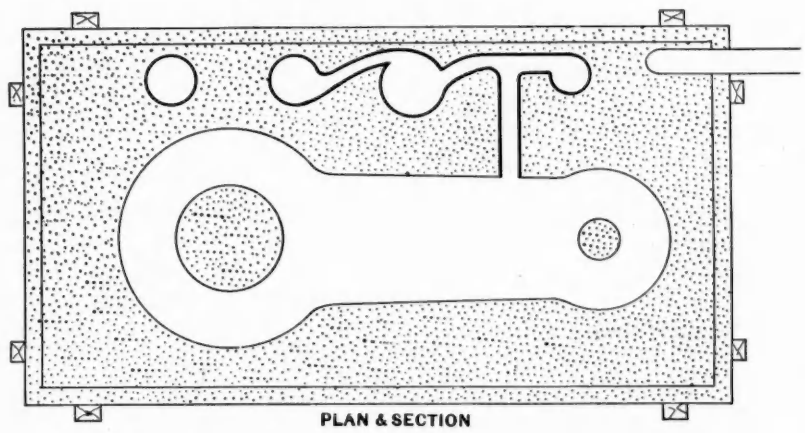
Skimming and Flow-off Gates.

BY THOS. D. WEST.

As melted iron contains more or less dirt and impurities, which keep rising to the surface of the metal, more especially while it is exposed to the air, it is of the utmost importance to have the runners and gates made so as to collect the dirt before the metal enters the mould, to insure a clean, solid casting. The gate shown is an improvement on the common skimming gate, as there is one more riser, or dirt catcher, in it, into which the iron goes circling round, whirling the dirt up to the top. It is astonishing how little thought some moulders have about the principle of skimming gates. Go into almost any foundry and you will see men making or working on good work, setting the largest runner for the pourer, and the smallest for the dirt catcher; or they will cut the gate that goes into the mould larger than any other portion of the runners or gates. I have also seen skimming gates cut when the man cutting them did not know which one of the upright runners was the one to pour into. This showed that, of course, he had given no thought to the subject. There were, in the instance referred to, two upright runners, with a channel cut between them, and he thought he was cutting a skimming gate. In the accompanying cut is shown a crank for an engine, bedded in the floor. To save work, the face is cast up, and it requires the greatest of care as regards clean iron going into the mould. The gate that leads into the mould is cut the smallest of any, so that the rest of the gates and runners may be kept full of iron. The dirt flows up to the top of the risers *A* and *B*. In this way clean iron goes into the mould. Risers *A* and *B* have no connection cut in the cope part, it being cut in the bottom, from *B* to *A*, and on a circle, so that the iron will whirl around in the riser *A*. The runner and pouring gate *D* are connected with *B* in the cope part, but can be connected in the bottom part, like *A* and *B*, should it not be practicable to connect in the cope. The pouring runner *D* is large enough to keep the lower gate full of iron, and the two dirt holders or risers are larger by one-third than the pouring runner.



LONGITUDINAL SECTION



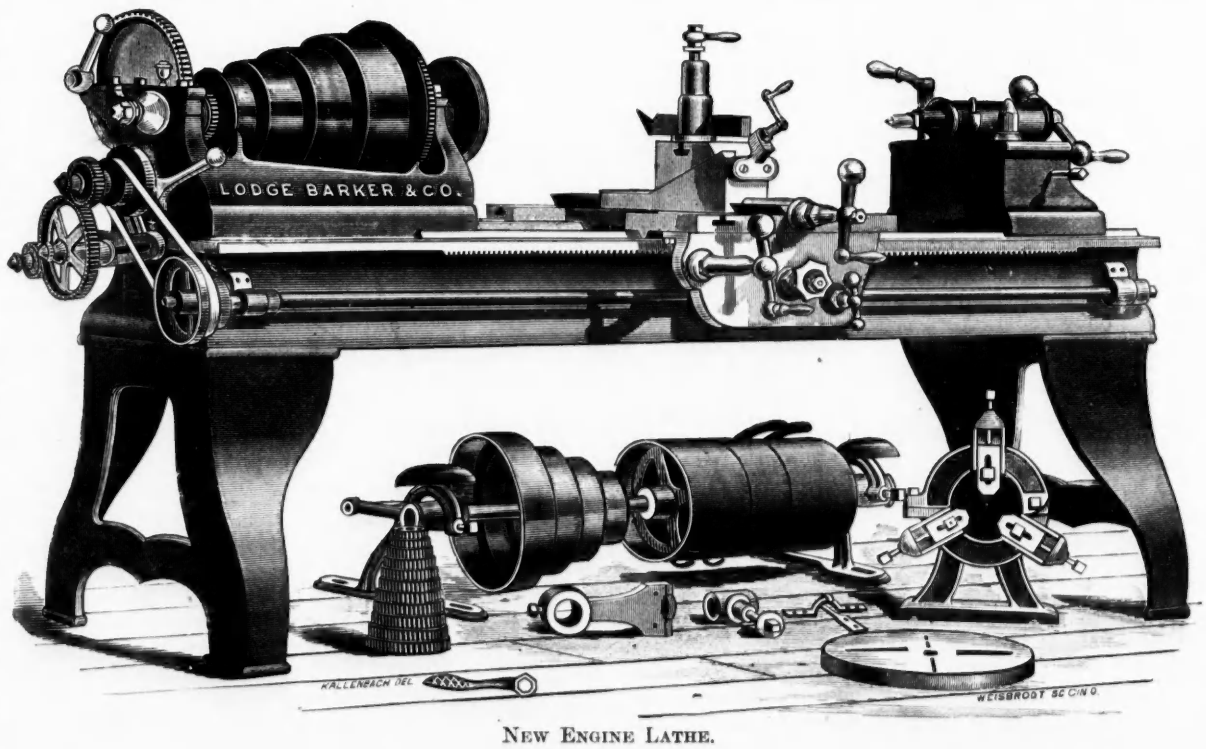
PLAN & SECTION

The pouring basin *M*, if for a very heavy casting, could be made longer, and a skimming core added, as shown in the previous article on "Gating and pouring heavy castings." All the runners should be rammed even, so that there are no soft spots in them, and all corners or edges of the gates and runners made rounding, so that the running iron can have no chance to wash sand into the casting.

The numbers 3 and 4 show a good plan of risers to take the strain off the mould when pouring. The riser 3 is connected with the pouring gate, and a clay ball stops the iron from flowing away, until the mould is full. It then flows down the outlet, under the joint of the flask. The connections between 3 and 4 can be cut down as low as 3 inches, which leaves very little strain on the mould. This is also used independently; but cutting the riser from the mould, and having three or four of them causes a sudden pressure on the cope. As a good skimming gate is essential in making a clean casting, so are good risers necessary to keep a casting from being strained. In this respect they are of equal importance, and too much attention should not be given to one to the exclusion of the other.

New Engine Lathe.

The engraving herewith presented represents a new 17½ inch engine lathe, made with special regard to the wants of American machinists. This lathe swings 18″ over ways and 11″ over carriage. The live spindle is made of the best forged cast steel, with front bearing 4½″ long and 2½″ in diameter. The boxes are made of the best special gun metal. This machine is designed to do heavy work to its full swing, and is yet constructed so as to be handled with great ease and rapidity. There is nothing heavy or cumbersome about it; but, at the same time, every part is solid and substantial, and strong enough to work without jarring or chattering.



NEW ENGINE LATHE.

The cone pulleys are of large diameter, and made for 2½ inch belt. This width of belt is very convenient to handle in throwing on or off, and the cone pulleys, being very large, make this lathe a powerful machine. Special care is taken to have the bearings of spindle perfectly cylindrical, insuring the work turned being round. All gearing is cut with the most improved cutters, and runs almost noiseless. The carriage is gibbed directly under the shears, and fitted to a perfect bearing by scraping. This cut shows an inclined elevating tool rest, which is fitted so as to be like a solid block. There are compensating devices for taking up lost motion or wear between the shoulders of the screw, and also in the thread. In fitting all gibs, the greatest care is taken to bed every piece solid.

The rest, as shown, is made only when ordered, the usual rest being a plain block, with circular tongue and collar for raising the tool. It has power cross-feed, and will face its full diameter with one setting of tool. All screws are of steel, including *the leading screw*. The feed rod is separate from leading screw, and the carriage has T slots for convenience in holding work. Each lathe is furnished with countershaft, steady rest, follow rests, gears, wrenches, etc. This lathe is made by Lodge, Barker & Co., No. 602 W. Fifth Street, Cincinnati, O., who make a specialty of this sized lathe.

The interest of the railway and navigation companies, in determining the natural resources of the country through which their lines pass, is noticeable. Attention was recently called to the determination of the Southern railroads to contribute in this way to the interest of the fair at Atlanta; and now the Northern Pacific Railroad Company and the Oregon Railway and Navigation Company are putting a scientific exploring expedition into the field, with Professor Pumpelly at the head. He will organize several expeditions to travel in different directions, and is himself examining the mining districts of Montana. It is intended that the work shall extend through several years; and though, of course, primarily in the interest of the companies mentioned, cannot fail in being of great advantage to the whole country.

Experiments are being made from on board the United States vessel Nina, at Newport, R. I., with a view to determine the efficiency of the Brush electric light to assist in detecting the approach of torpedoes. So far as tried, the experiments are said to have been highly satisfactory, the brilliancy of the light being unaffected by the wind or the roll of the vessel. Two lamps are to be used; but the whole current can be switched to one light, rendering it very intense.

Shop Kinks.

No. 14.

By L. F. Lyne.

RUNNING LINES AND PUTTING UP SHAFTING.

The apprentice who learns his trade in a railroad shop, or in a manufactory where special tools are made, seldom, if ever, gets an opportunity of acquiring an experience in putting up shafting. I know, while an apprentice, I used to closely watch the process of hanging shafting whenever I got a chance, which was very seldom, and would have given any of my earthly possessions at one time, in exchange for a knowledge of the various details used in putting up shafting, which I saw laid out in a very mysterious way by the "boss."

It is my purpose in this and one or two following articles to give some of the details, which are likely to occur in a general practice of laying out the lines for locating shafting and machinery.

It is well to state at the outset that shafting is generally put up by workmen using a common carpenter's steel square and a chalk line. To set one line for shafting at right angles to another, the steel square, which may or may not be exactly 90°, is applied to two chalk lines placed at what are supposed to be right angles to each other. This and many of the other details usually carried out render the process about half guess work.

When the shafting has all been hung and the belts put on the pulleys, it has frequently been found necessary to move some of the shafting more or less, in order to get the belts to run properly.

I shall take the ground at this time that it pays to do work right at first, and assume that the pulleys to go on the shafting have all been turned properly, otherwise a person cannot tell where the road selected and followed will lead to.

Suppose the buildings A, B, C and D, shown in Fig. 1, have been erected for the purpose of manufacturing a general class of machinery. A man is sent to examine the buildings for the purpose of putting in the shafting, machinery and tools.

Suppose that each of these have been located upon the drawings by the draughtsman; the first thing in order is to run a center line for the main shaft, *a b* in Fig. 1. I always use a fine sea grass line for this purpose, but have seen good work done by a smooth chalk line in the hands of a careful workman, but it don't pan out as a rule. The class of work done with a fine line is more satisfactory, however, and it should always be used when procurable.

The distance from *a* to *b* is supposed to be 275 feet, as it was in one case during my experience. Stretch a line the whole length, fastening the two ends in the positions located from the drawings for the ends of the main line shaft. The line will sag considerably, and, after being drawn reasonably taut, a plumb line should be dropped from a beam at or nearly half way between the two ends, and the line taken up at this point. After taking up and fastening the line at the middle, the same process should be repeated until the points taken up are only a sufficient distance apart to insure a straight line from end to end.

A permanent center line should now be made upon each of the timbers for supporting the hangers, using a plumb bob suspended by a piece of sea grass line for accuracy.

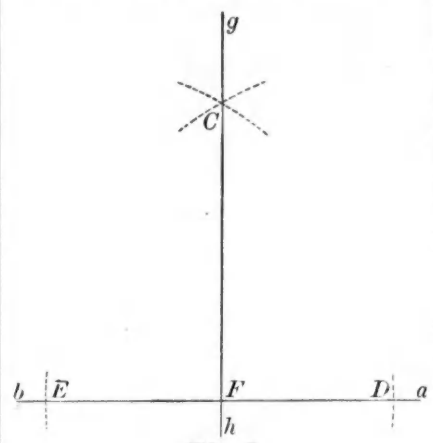


Fig. 2

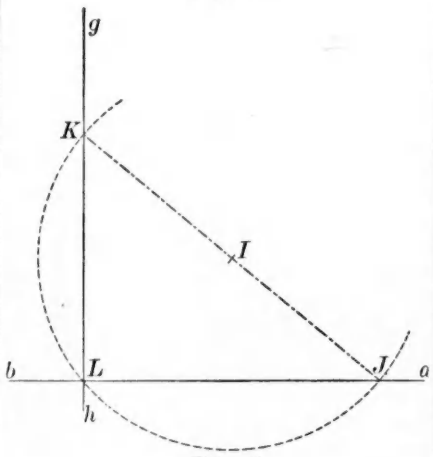


Fig. 3

After locating the points upon each timber for the main line shaft, it is necessary to run a line at right angles to the first, for the purpose of setting the steam engine in the engine room *C*, to drive the shop. This may be accomplished in a variety of ways, probably the most simple is that represented by Fig. 2, where *F* represents the center line of the main pulley, it being understood that in all cases center lines are to be found, and worked from, which course is easy and avoids confusion.

A good plumb bob with a fine true steel point is indispensable in this kind of work.

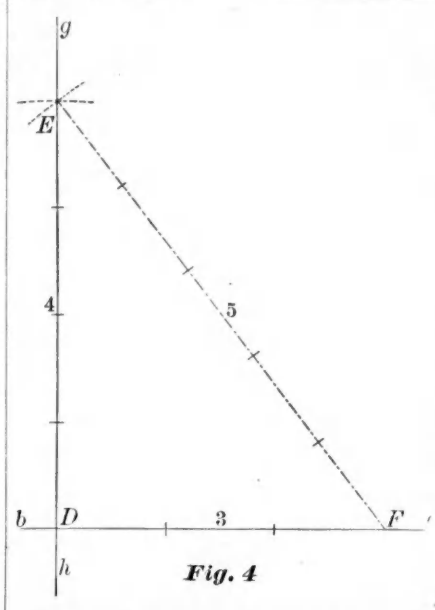


Fig. 4

Drop the plumb bob from a point *b*, previously made upon the timbers overhead, to the floor, and nail a strip of board to the floor, directly under the plumb bob.

Then drive a nail into this board directly under the point of the plumb bob, and mark the same with a fine center punch. After this drop the plumb line from the point marked 14, or any other convenient distance, upon the main line to the floor, and mark in the same manner. The strips of board are used for convenience in finding the marks in the nail heads, also to raise the line clear of the floor when it is stretched between the two points, which will be designated as *a b* in Fig. 2. Set a pair of good stiff fine pointed trammels to any convenient radius, and from *F* as a center describe two short arcs, cutting the line *a b* at *E D*. Then setting the trammels to any radius, using the points *E* and *D* as centers, describe arcs cutting each other at *C*. A line *g h*, drawn through the points *C F*, will be at right angles to *a b*.

This problem can only be made use of when there is plenty of room upon each side of the point *F*.

When this point is near the end of a line, as shown in the case of Fig. 1, the problem shown in Fig. 3 may be employed.

Let *a b* represent the main line as before, and *L* the center of the main pulley. Then with the trammels from any center, *I* above the line, describe a circle passing through the point *L* and cutting the line *a b* at any point *J*. Draw the line *J I* and produce it to cut the circle at *K*, and draw a line *g h*, through the points *K L*, which will be the perpendicular required.

It is not always possible to use this problem in practice, for the reason that there may not be space enough to use the trammels in drawing a large circle. The points *L J* and *K* should be separated as far as possible, as it reduces the errors incidental to the use of a line. To accomplish this the writer recommends the use of what he considers the most practical problem for producing a right angle without the aid of a square, and which is capable of being generally applied in practice.

This problem is shown in Fig. 4, and is very much used by carpenters and builders.

Let *a b* represent the main line shaft, as before, and *D* the center of main pulley. Then from *D* with the trammels set off a distance *D F*, equal to three parts by any scale, and on the centers *D F*, with radii of four and five parts respectively, as shown, describe arcs intersecting at *E*. A line *g f h* drawn through the points *E D* will be the perpendicular required. This problem is useful on very large scales where straight edges and squares are inapplicable. The parts 3, 4 and 5 are taken to measure respectively the base, the perpendicular and the slant or hypotenuse of the triangle.

Any multiples of these numbers may be also used with equal accuracy, as 6, 8, 10, or 9, 12, 15. These numbers may represent feet, yards or any other measure of length.

Having placed the line *g h* in Fig. 1 at right angles to *a b*, we attach one end of the line *g h* to a strip of board nailed to the wall of the engine room, while the other end is tied to a nail in a block fastened to the floor of the machine shop. A templet for the bed plate of the steam engine should now be made of well seasoned lumber of sufficient thickness to prevent it from springing. For directions in making and using the templet I would refer the reader to an article on Setting Up Engines, by V. Hook, which appeared in the American Machinist of Aug. 16, 1879. After the templet has been finished and the center line of the cylinder placed upon it, the templet should be set in position and supported by timbers sufficiently heavy to prevent it from moving, after being carefully set by the line *g h*, while the foundation is being built. Much trouble is frequently caused by improperly supporting the templet, or removing the same from the anchor bolts altogether before the foundation is built up to it. I remember one case where the templet was removed before the proper time, and two of the anchor bolts were found to be several inches out of place, so that a portion of the foundation had to be removed, the bolts cut off, and an offset clamp used to bring the bolts in the right place. Some of the bolts were too short owing to the sagging of the templet, due to its own weight. The writer on one occasion set up a stationary steam engine under peculiar circumstances.

The templet for the engine was carefully made, and the holes for the anchor bolts bored. After running the line *g h*, the templet was strongly supported upon three 6″ × 6″ timbers, and after setting the templet by the line, the masons were ordered to begin

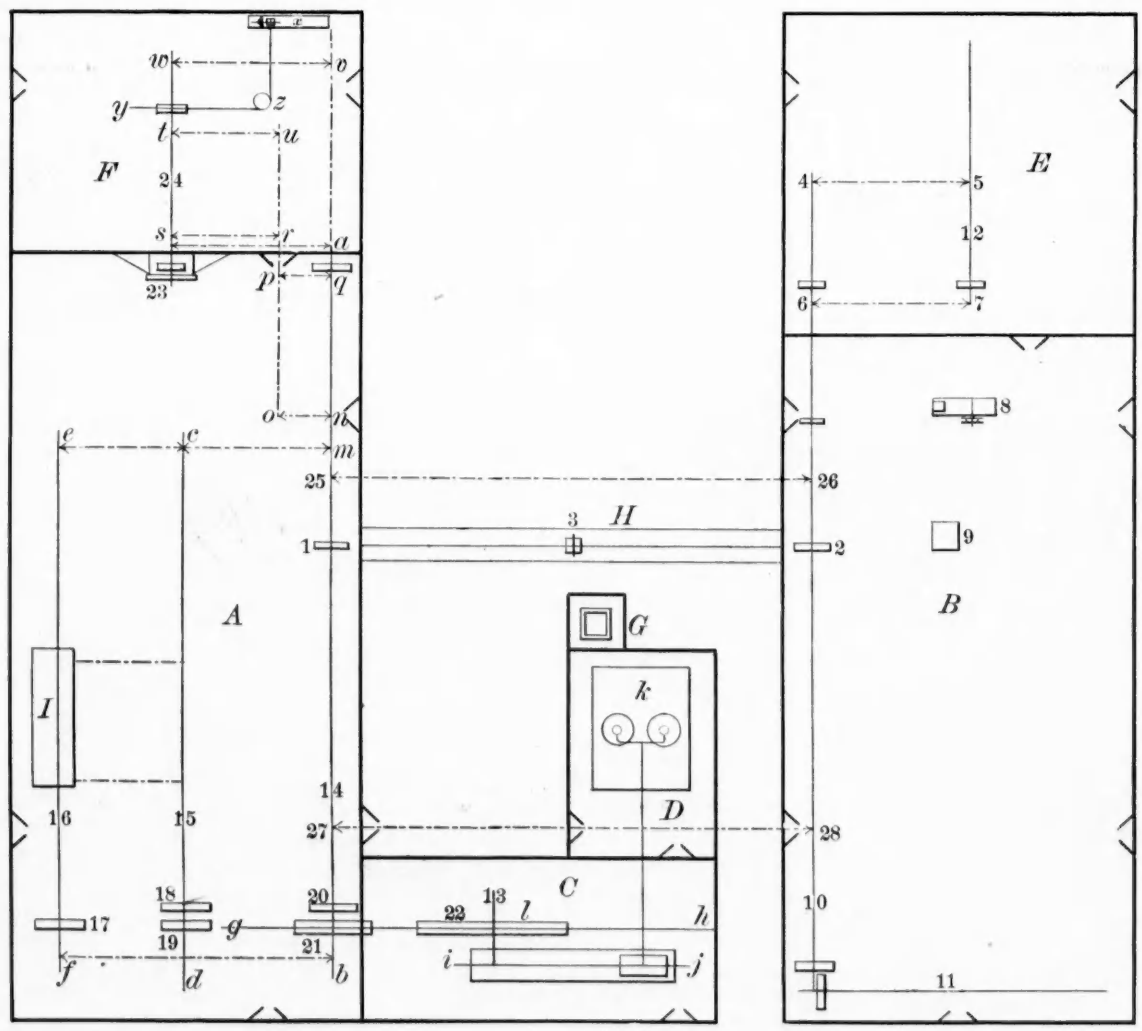


Fig. 1

the foundation, which was to be of stone. When the stone work was built up within about 30″ of the templet the masons requested that the templet be removed, which request was emphatically refused, and caused an open rebellion. The only way peace was restored was by going through an explanation to the workmen in detail, in order to show the necessity of adopting the course insisted upon. When the mason work had progressed within about 12″ of the templet, the anchor bolts were all securely wedged in their respective positions, and the templet removed. The cap stones of the foundation were then put in place and left for a week, to allow the cement to thoroughly dry.

No time was lost by this process, as the workmen were engaged in the meantime with other work about the shop.

Mechanical Drawing.

CONE PULLEYS, EXPANSION CURVE, EFFECT CONNECTING ROD ON CRANK.

BY PROF. JOHN E. SWEET.

In the consideration of the subject of the proportioning of cone pulleys, left incomplete in the last article, it was assumed that the countershaft was several feet from the lathe, and that the pulleys were of nearly the same size. When the pulleys on one shaft are quite large, and those on the other small, and where the shafts are not far apart, as is the case in a foot lathe, then another factor, the angle of the belt, enters into the problem.

In this case, as will be seen by reference to Fig. 23, the step, or amount one pulley is larger than another, is greater in the upper cone than in the lower one. This is necessary in order that the belt may be equally tight in all positions. Fig. 23 gives a graphic method of determining the sizes required.

I would advise my apprentice friends or students to hunt about for an old foot lathe wheel, or small cone, that might do for the spindle of a foot lathe, and set themselves the task of making a drawing of a pulley, or wheel, to run with it. In Fig. 23 it is assumed that the size of the different lifts of the driving wheel are known and represented by the three circles below, and that the distance between the centers of the shafts is known.

Draw the vertical line *AB*, and set off the centers of the two shafts the proper distance apart, either full size, or to some scale. Strike the circles of a size to correspond to the wheel or pulley that is already made. Half way between the centers of the two shafts strike the horizontal line *CD*. Determine the size of one of the steps of the wheel or pulley desired, and draw a line to represent the belt *EF*. Strike two other lines, *GH* and *IJ*, so as to just strike the other two circles and to cross the line *CD* at exactly the same point. Circles *KL*, drawn so as to just strike these lines, will give the size of the other pulleys required. This method is not absolutely correct, but the error is so slight as not to be noticeable in using the ordinary leather belt.*

Fig. 24 shows a method of drawing a very useful curve. First, draw the four lines bounding the figure of any size or proportion. Then draw the 3d vertical line *AB* near one end. Divide the line from *A* to *C* into a number of parts of equal or unequal size. From these points, strike vertical lines and diagonal lines to the lower opposite corner. Where the diagonal lines cross the line *AB*, strike a series of horizontal lines. Through the points where the vertical and horizontal lines join, as at *D*, *E*, *F*, and so-forth, strike the curves. Making this diagram is good practice; its use can be better learned and understood when the use of the steam engine indicator is mastered.

Fig. 25 illustrates some of the peculiarities of the connecting rod, pitman or shackle bar of a steam engine or pump.

Strike the circle to represent the path of the crank, which we may assume to be 12 inches in diameter, drawn full size or to any scale. The line *AB*, passing through the center, gives the direction of the travel of the center of the cross-head pin. When the crank is at *C* the cross-head pin would be at *D*, and when at *E* the cross-head pin would

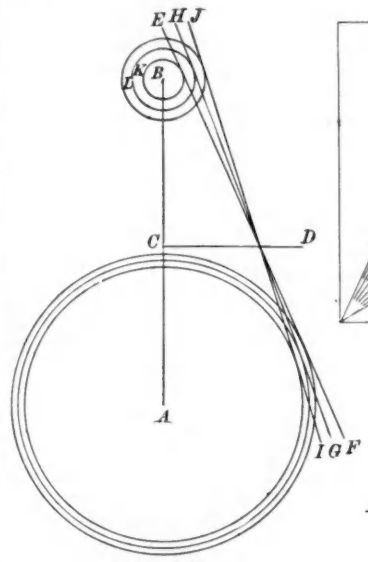


Fig. 23

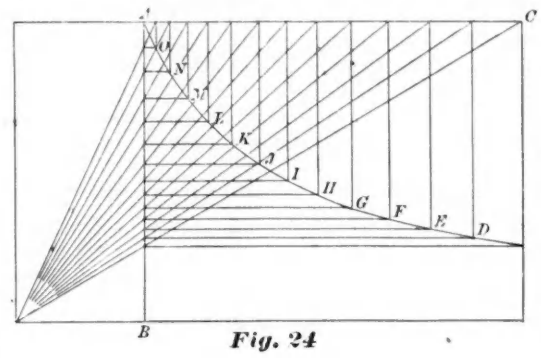


Fig. 24

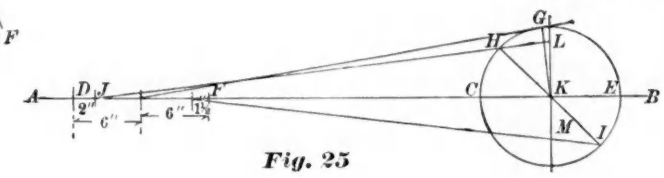


Fig. 25

be at *F*. When the cross-head has moved half way from *B* to *F*, the crank would be at *G* only. With a crank moving at a uniform rate, it will be seen that the cross head must travel faster at the end farthest from the crank, for when it has moved one-eighth of a revolution from *G* to *H*, the cross head will have moved two inches, whereas where it has moved one-eighth of a revolution, from *E* to *I*, the cross head will have moved but 1½ inches only.

If the same power be applied to the cross-head in each case there would not be the same tendency to rotate the crank when at *I* as when at *H*. To determine what that difference is by the aid of the diagram, is a very simple matter. Continue the line *JH* through to the vertical, and as much greater as the distance from *K* to *L* is greater than from *K* to *M*, so much greater is the rotative effect when the crank is at *H* than at I. And, too, this is a simple way of determining the amount. One hundred pounds applied to the crank, when at *H*, will have the same effect as if applied to a crank at *L*.†

* This method of determining the size of cone pulleys was illustrated some months ago in the AMERICAN MACHINIST, and in the *American Artisan*, Feb'y, 1874.

† For the last two of these digrams, I am indebted to Jesse Warrington, formerly of the Buckeye Engine Works, whom I believe to have been the originator of them.

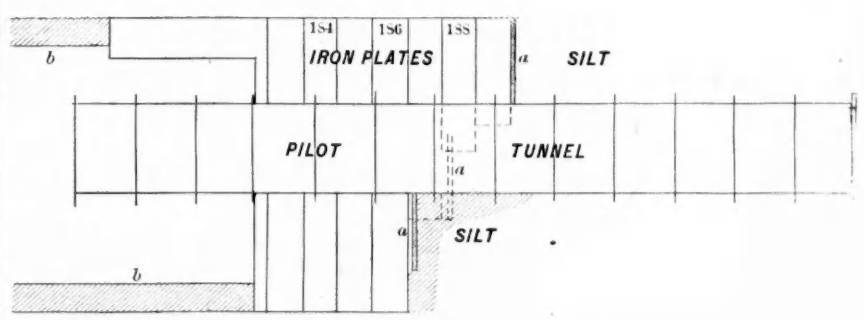


Fig. 1

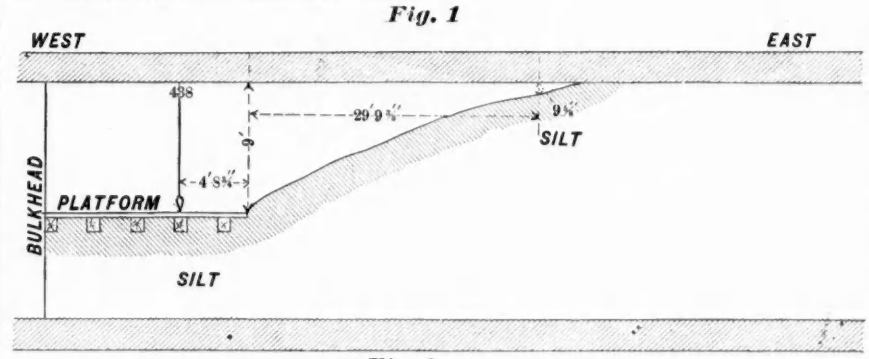


Fig. 2

TUNNEL SECTIONS.

Testing the Hudson River Tunnel.

The first critical test of the finished portion of the Hudson River tunnel has been recently passed in safety. A bulkhead or wall was built in each of the tunnels at a distance of about 425 feet from the shaft. Two air locks were placed in each bulkhead, one to be used for working, with a standing order to keep the inner door of the other open all the time, in case of accident, so that the men could enter and escape any threatening danger. After the new air locks were placed in position, a pressure was put upon them before letting it entirely off the old works or the finished portion of the tunnel.

The South tunnel was tested first on July 6, 1881, and when the pressure within the air locks reached 23 lbs. per square inch above the atmosphere there was an escape of air through the extreme heading, which also forced its way back through the bulkhead into the finished portion of the tunnel. A difference of only about 3 lbs. in pressure existed between that in the new air locks and the finished portion, as the usual pressure is about 20 lbs. to 20½ lbs. per square inch.

The pressure within the new air locks was, however, maintained for about three hours, when the silt at the heading becoming dry, the pressure was reduced to 1 lb. per square inch, and no further escape of the air at the heading was noticed.

On the morning of July 15th, the brake on one of the small push cars loaded with brick gave way, and power to control the car being lost it ran against the door of one of the air locks, forcing it open and allowing the air pressure to equalize. No damage was done and the door was closed and the pressure within restored. On August 8th, the air pressure in the headings of both the North and South tunnels was raised to 26 lbs. at mean high water, while the pressure in the old works was lowered to 12 lbs. per square inch. This pressure was found too great and blew out at the headings, so it was lowered to 22 lbs.

On August 11th the workmen were all taken out of both headings, as well as the old works. All the pressure was then let off the old works, after which Assistant Engineers J. S. Finch and S. H. Raymond, together with the Superintendent of miners, and several others, cautiously entered the old caisson and began an inspection. A small leak about ½ inch in diameter, was discovered at the junction between the walls of the caisson and shaft. There were several other leaks of less importance, which have since stopped of their own accord.

When the air was let off the old works it was noticed that the pressure did not fall as rapidly as it should have done had it not been re-inforced from some source, and when the mercury gauge indicated about one lb. pressure, it would not go any lower, so the door of the air lock to the old works was forced open with a hydraulic jack. Col. D. C. Haskin, President of the Tunnel Company, and General Wm. S. Smith, the present Chief Engineer, then entered and inspected the works, pronouncing them satisfactory.

At about 4.30 P. M. the workmen entered the heading of the South tunnel, then in the condition shown in Fig. 1 of the accompanying engravings. The finished walls are represented by *b b*, the offset at the end of the finished walls representing a section walled up ready for the key to be inserted to finish it.

Beyond the unfinished section the iron plates with their numbers are shown, also the bulkheads *a a a*, made of plank placed in the headings. A bulkhead *a*, of plank, is also seen at the extreme heading of the pilot tunnel.

The brick walls were finished about 65 feet from the inside of the bulkhead or air lock. The workmen noticed some of the bolts which held the plates were shearing off, and the pressure was falling owing to leaks in the bulkhead.

The air compressors were run to their full capacity, but were unable to supply the demand for air, so all the workmen left, except a few who remained to watch what would occur. In the meantime, the doors of the air locks to the old works were closed, when the pressure rose rapidly to ten pounds per square inch.

This pressure being insufficient to sustain the pressure of silt, some of the iron plates came down, and the silt began to creep through the openings thus made into the tunnel, so that in two hours the South heading presented the appearance shown in Fig. 2. In other words, the South heading crept in about thirty feet in two hours; the silt, however, being very dry and hard. The 9⅝″ mark indicates the distance from the top of tunnel to the silt at the point where the measurement was taken. The inside of the bulkheads were washed with Portland cement, and on August 16th the pressure in the old works was reduced to seven pounds per square inch, and on the following day it was entirely removed; since which time there have been 450 feet of finished tunnel open to the atmosphere.

An Eads Sand Pump has been in use since July 21st for removing the silt. It works on the principle of an ejector, only. Instead of using steam, a strong current of water is forced through the apparatus by means of a Worthington duplex pump.

The silt is mixed with water in a box, and is then forced out through a pipe to the surface of the ground, where it runs through a wooden trough, and is deposited well up on the land without handling. This pump works very satisfactorily, and requires little attention.

At the time of our visit the south heading was being put in order for working, and the work is progressing rapidly in the north heading. The success of the work depends upon constant vigilance, as a blow out at the headings is likely to occur at any moment.

When a slight blow out is observed by the escape of air through the water, a reduction of half a pound in the pressure is sufficient to stop it.

The work since taken in charge by General Smith is conducted on a safe principle, and an avenue of escape for the men is always open should any unforeseen accident occur at the headings. A mule has been placed in the tunnel, and is used in hauling material to and from the headings.

Apprentice Papers.

VIII.

BY CHORDAL.

CAPILLARY ACTION.

Capillary action is something noticed every day. While this is the action of a force, and not a force itself, it may be well to speak of it at this point, and to speak of it as capillary force.

If water be poured into a tumbler and allowed to come to a quiet standstill, it will be noticed that the water touching the glass stands slightly higher than the general level of the water. It forms a rounding little fillet all round the inside of the glass. According to all laws of gravity the water should be level where it touches the glass as well as elsewhere. If the tumbler is only a quarter of an inch in diameter, instead of two or three inches, it will be found that the fillet of upheld water is so great as to give the whole water surface a saucer-shaped or concave form. Gravity tends to draw this water down to a level, and some other force must be present to hold it up. That other force is capillary force. This force may be described as a force tending to attract the atoms of some liquids to the surfaces of some solids.

If we push a small glass tube into a tumbler of water, we find that capillary force draws the water up into the tube some little distance, and that the top of this little column of water is filleted against the bore of the tube. We also find fillets on the outside of the tube. The more surface we present to a small quantity of water the more the capillary force exerts itself. If we take a tube with a very fine hole in it, much smaller than a hair, we find that the water rises in it to a considerable distance. Such tubes are called capillary tubes, and the word capillary means "like a hair."

Capillary force will attract to the surface of a body almost any liquid which will wet it. If a glass rod or tube be oiled, water will not wet it, and little capillary action will show itself. Quicksilver will not wet glass; and if quicksilver be poured into a glass tumbler it will not form a rising fillet around the edges. It will do just the other thing. It will curve downward and leave the main surface higher than at the shore. If a small tube be plunged into quicksilver, the surface of the quicksilver will be convex, or rising, instead of concave; and the quicksilver, instead of rising in the tube above the level of the tumbler, will stand below it. If the tube be very fine, like a capillary tube, the quicksilver will stand very much below the larger level.

If water be sprinkled on a clean wooden floor, the drops will be immediately flattened down by the gravity of the water in the drop, and each drop will spread out and cover much surface. If the floor be dusty, capillary force of the *non*-attractive character will act between the dust and the drops of water. The water, instead of spreading out and wetting the dust, will form in brilliant little balls, which roll around freely, and seem to try to touch as little of the dust as possible. While gravity tends to flatten and level these balls of water, capillary force sustains them in globular form.

Quicksilver will wet very few substances, and if poured in drops on almost any surface it will form into balls instead of flattening out.

The pores in almost all substances act as capillary tubes. Blotting paper is an open, porous kind of paper. If the edge of a piece of blotting paper be dipped in ink or other liquid which will wet it, the liquid will rise up in the little pores and will soak the whole piece.

If the same kind of blotting paper be calendered, or hard pressed, the pores will be closed up so closely that it will no longer soak up liquid. If one end of a piece of soft string be dropped in water, capillary force will lift the water up in the fine spaces between the delicate strands, and finally the whole string may be wet. It is on this principle that a lamp wick acts. The lower end of the wick being in the oil, capillary force draws the oil upward among the fiber surface, and, at the top, the heat of the flame turns the oil into gas. This gas burns, and new oil is being constantly attracted upward by the comparatively dry upper part of the wick.

If a loose piece of cloth be hung over the edge of a vessel of water, capillary force will cause the water to creep up the pores of the cloth, then down the cloth, where it may form a drop on the end outside the vessel. This drop will soon fall off and another form. In this way the water may all be lifted from and out of the vessel. When the pores of a substance are filled with liquid drawn into them by capillary force, we say that the substance has "soaked the liquid up." It is this "soaking up," this capillary force, which brings moisture through brick walls, which fills a sponge, which carries the moisture from the earth, in the form of sap, up through the pores of plants and trees, and thus nourishes them, and it acts largely in distributing the blood and other liquids in our bodies.

Capillary force is a very limited force. It will not elevate much liquid, or elevate it very far. Thus, a lamp, so constructed as to have the flame end of the wick a foot above the oil surface, would not burn, because the capillary force was not sufficient to lift the oil so high in sufficient quantities to feed the flame.

If the hydraulic engineer wishes to measure accurately the depth of water in a stream or weir, he cannot do so by simply plunging a measuring rule in the water, for capillary force will draw the water up around the rule and show the surface to be higher than it really is. In making such measurements accurately, a rule is used, which rests on the bottom of the stream, and is provided at the bottom with a slide, having a delicate, sharp point at its top. This slide is under water, and is pulled upward until the fine point just appears at the surface of the water. The depth can then be measured on the rule from the point to the bottom of the rule. Such an instrument is called a hook gauge, and its use is rendered necessary by the existence of capillary force.

New Hollow Grate Bar.

It is well understood that the majority of boiler furnaces coke a great portion of the coal placed in them, furnish abundance of ashes and clinkers, and allow the loss of large amounts of combustible gases which should find their way as sources of heat to the water they ought to evaporate in the boiler.

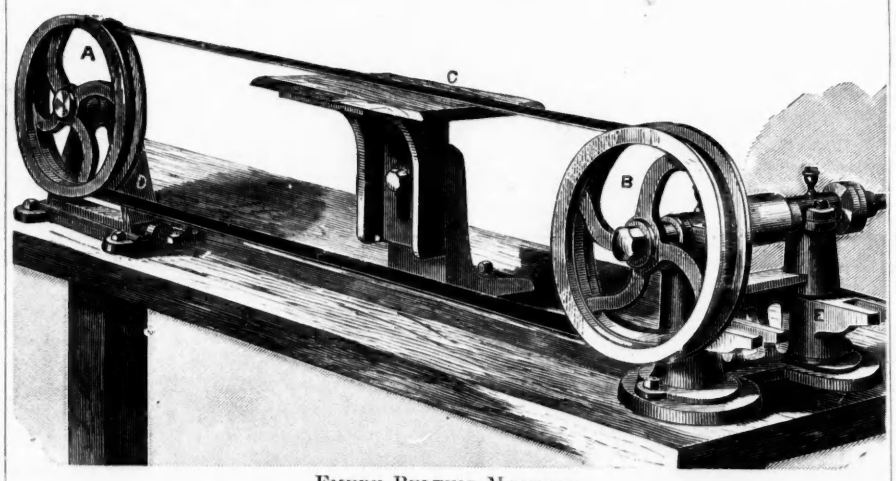
While great care and much time have been expended in perfecting the steam engine, a greater need is an economical and easily-managed method which shall be certain in effecting a consumption of the fuel placed within the furnace.

In ordinary furnaces, great quantities of fuel are burned and destroyed because of the inability of the gases to obtain sufficient oxygen to sustain combustion. The much-needed oxygen is generously supplied to oil stoves and kerosene lamps, from necessity, to prevent smoke, but in boiler furnaces, the steam user is generally content to allow sufficient air to enter his furnace to keep a fire near the front of the grate, while the middle and back part hold masses of unconsumed coal that merely coke to a mineral residuum, or turn to slag. The coal, meanwhile, releases the imprisoned gases, which escape unconsumed up the chimney, whereas these gases, if heated to inflammability, are capable of producing intense heat. It is largely for this reason that coal bills frequently assume such gigantic proportions in comparison to the quantity of work done, the fact that the fire does not burn freely, or covers only a portion of the grate surface, being often erroneously regarded by steam users as indicating a saving in coal.

NEW HOLLOW GRATE BAR

It has seemed that the proper method of consuming the fuel and deriving from it its heating properties should be begun and carried out while the fuel is in its proper place, upon the grate of the furnace, and combustion is going on naturally. The fire, if burning in an economical manner, should be equally bright all over the grate surface; or if there is any difference at all, it should be hottest at the back part, where the impetus of the draft with its heated oxygen should cumulate and compel a combustion of the gases evolved from the crude coal placed near the front of the grate, where the admission of air is the most liberal.

The object of the ventilated grate bar, represented by the accompanying engraving, is to remedy these difficulties.



EMERY BELTING MACHINE.

It is a hollow, cast iron grate bar, cored in casting with one or more lateral or side apertures upon each side, near the rear end, while the front end remains open, as represented by the engraving. The boiler requires no special setting.

In the ordinary grate bars the space occupied is the same as with the bar here shown, the air passing up between the bars in both cases, and admitting the replacing of a defective or worn out bar, without disturbing the remainder. But unlike other grate bars, this allows the atmospheric air from the draft hole in front of the furnace, and from the ash pit, to enter near the front end of the bar, and traverse nearly its whole length.

The air is heated in its passage, and emerges through the side openings, near the rear end of the furnace, without undergoing any chemical change. The hot current thus emerging instantly and constantly, mixes with and ignites the gases, which would otherwise escape unconsumed.

The side openings are provided with a hood to prevent their being stopped by ashes and clinkers. These bars are, in short, a continuation of the draft door, and supply as much atmospheric air to the coal at the back part of the furnace as is obtained by the usual draft at the front end. They are made by the Fairbairn Manufacturing Company, 272 Purchase Street, Boston, Mass., and are used by some of the leading New England manufacturers, who speak well of them.

Emery Belting Machine.

The machine shown by the engraving presented herewith consists of an emery grinding stand *E*, with a spindle, upon which is placed the double flanged wheel *B*. A second wheel *A*, is mounted upon a stand at a suitable distance from *B*. An endless belt, with the surface coated with emery, is placed upon the wheels alluded to, and is brought to the proper tension by a screw attached to the slide *D*. A small adjustable table, *C* is placed between the wheels, and is set sufficiently high to slightly lift the belt, so that by placing any piece of work against the upper side of the belt a true flat surface may be obtained. Another attachment not shown may be placed across just over the belt, to prevent the work from being thrown off by the belt, and enables the workman to hold his work square at right angles to the belt. By removing the adjustable table *C*, the machine is in substance the old style of belting machine, only built in a more substantial manner. Machines of this character are invaluable for polishing the surfaces of all kinds of metal work, bone, wood, and ivory, laying the grain upon steel rules and other tools, though not, as many suppose, for taking off any quantity of metal, or reducing the sizes of different articles. The belts used upon these machines are made in one piece, without any lacing or hooks.

They are generally made of two thicknesses of strong canvas, with vulcanized rubber between to hold them together.

The joints are made so as to present a smooth surface, which may be covered with either sand or emery of different grades. In old times when a manufacturer wanted a belt machine, he made it himself. Now, an improved machine for this purpose is placed in the market as a regular article of manufacture. These machines are made by the Brady Manufacturing Co., 257 and 259 Water St., Brooklyn, N. Y.

Speaking of the new Chicago Court House, the *American Furniture Gazette* shows how so-called "conveniences" in buildings can be made to cost more than they come to :

Architect Egan evidently thinks that, as a people, we need more physical exercise, and has wisely planned his elevators so we will have to take it. The four huge elevators provided, are all placed in the back central portion of the building, so that to reach many of the rooms we either have to trot up stairs or trot half a block to get lifted, and when as high as we wish to go, trot half a block back to the corner whence we started. This arrangement must be purely in the interest of public exercise, as the well-holes of the stairways at each end of the building afford excellent and most natural opportunities for elevator ways.

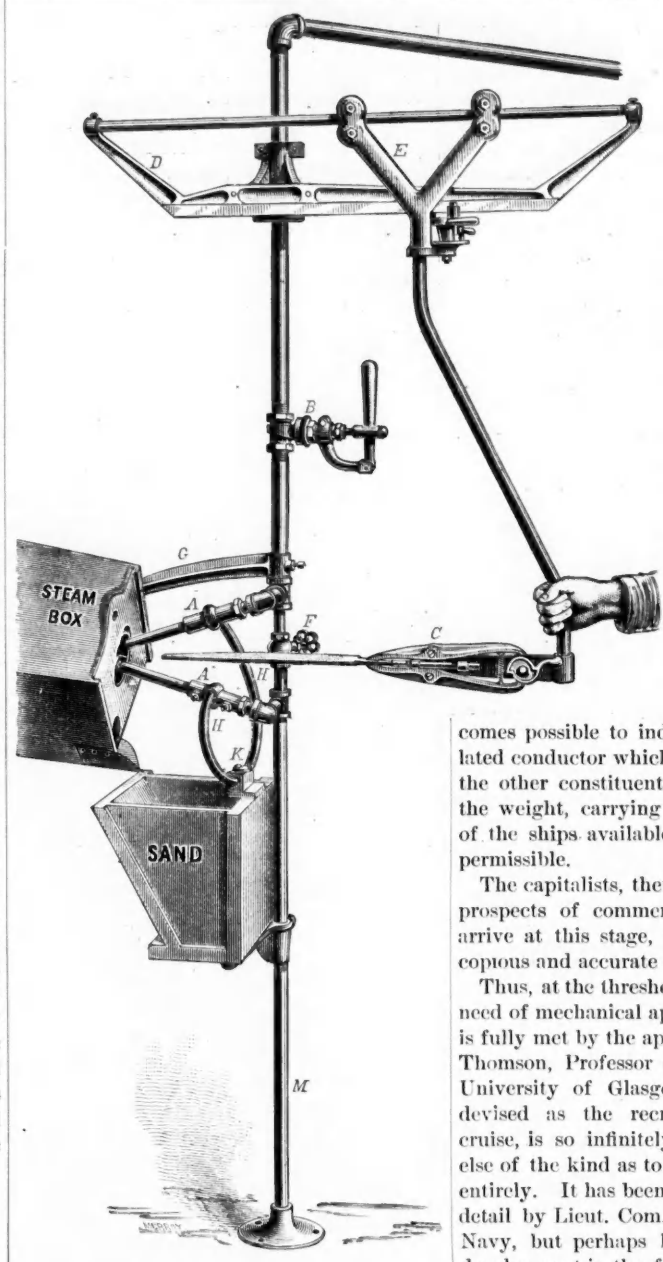
Railroad building is progressing faster than it did last year. The *Railroad Gazette* of Aug. 26th has information of the laying of 279 miles of new road, making a total of 3,459 miles this year, against 2,853 miles reported at the corresponding time in 1880.

The Sand Blast File Sharpening Process.

The economy of the sand blast for sharpening files is now so well understood as to need no argument in its favor. It is quite generally used for sharpening old and worn files, which it does almost instantly. The manufacturers also claim that it has been adopted by some leading file manufacturers for the purpose of removing the curl on the extreme end of the teeth of new files, adding materially to their working value.

The accompanying engraving represents the latest improvements made in the sand blast device by the Sand Blast File Sharpening Company, Wilmington, Del. In this engraving is seen the steam pipe from the

boiler connecting as, shown, with the brass guns *A A*, through which steam and sand are blown into the steam box, and from which the steam escapes through an uptake (which is not shown). These guns are connected by rubber hose *H H*, to sand pipe *K*, which enters the sand box. This box is kept partially full of sand or quartz and water. In using this device, the file to be sharpened is held in the pliers *C*, and steam is admitted to the guns through the quick-opening lever valve *B*. The current of steam lifts, by induction, the water and sand from the sand box and projects the sand with great velocity through the guns, which it will be seen are placed convergently, and so that the two currents will meet just inside the steam box. It will be seen that the pliers in which the files are held are suspended by a traveling carriage which works on overhead ways. Attached to this carriage, and in connection with the ways just mentioned, is an arrangement for giving a lateral motion to the carriage as it is moved forward or backward. From this description it will be seen that the file may be readily moved into and out of a position to be operated upon by the two sand currents, and that it receives at the same time a reciprocating lateral motion, the object of which is to present all parts of it to the equal action of the blast. At *F* is an ordinary globe valve, the purpose of which is to shut the steam off one of the guns when one is to be used separately. The sand and water finds its way back from the steam box and into the sand box, to be used over again; while any excess of sand and water in this box is conducted to another one situated below it, from which the sand is taken for further use. The bracket *G* is for the purpose of holding the different parts of the device steady in relation to each other, and completes the connection of all the members to the upright pipe *M*, which, being fastened to the floor, makes the whole partake of the character of a complete machine.



SAND BLAST FILE SHARPENER.

The Latest Methods of Submarine Telegraph Work.

BY THOMAS WHITESIDE RAE, C. E.

A PAPER READ BEFORE THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

This branch of engineering is of comparatively recent growth, and at first glance may seem hardly to be mechanical in its characteristics. The popular impression—among those who devote any thought to it at all, is apt to be that it only involves the functions of the navigator and seaman.

The real case is, that only well-built and accurately-working machinery, designed by the light of experience gained in all kinds of weather and over all varieties of ocean bed, writes successful submarine telegraph work upon the list of engineering possibilities.

It is interesting to trace how entirely, from the first step, the prosperous conduct of an enterprise of this nature depends upon the perfection of the mechanical appliances employed in it.

For example: The construction and laying of a sub-marine telegraph must be regarded from two points, viz., as an engineering problem, the sagacious solution of which stimulates professional pride; and as a commercial question, whose satisfactory answer is the only justification of the time, money and labor devoted to the undertaking.

About the most important factor in the financial success of a sub-marine telegraph is its capacity for business, or, in other terms, the number of words it can transmit in a given time.

This fixes its revenue-producing power. Statistics show very distinctly the ratio between the foreign commerce of a people and the extent of its telegraphic correspondence; and this is the source from which the fund must come that shall cover the cost of maintenance, pay interest on the original investment, provide for complete renewal in twelve or fifteen years at the farthest, and afford satisfactory dividends to the stockholders.

The first duty of the engineer is to decide how great a capacity of transmission the submarine telegraph—more conveniently styled cable—may have. Rapidity of transmission means size; size means weight. These, in turn, imply ships of sufficient tonnage; and it becomes apparent that not a step in the enterprise can be safely taken until the proposed route be made the object of an exhaustive survey.

Where the length of the longest uninterrupted circuit is known, where the greatest depths of water, the profile of the ocean bed and its chemical constitution along the projected course are discovered, the engineer can predicate with reasonable exactness how much shall be of a certain tensile resistance, and how much of another, and whether or not any portion must be protected from destructive action of the surface on which it will lie.

These essentials to durability being definitely decided, it becomes possible to indicate the largest insulated conductor which, in combination with the other constituents of a complete cable, the weight, carrying and stowage capacity of the ships available for the work, render permissible.

The capitalists, then, may judge what the prospects of commercial success are. To arrive at this stage, resort must be had to copious and accurate deep-sea soundings.

Thus, at the threshold of the enterprise, the need of mechanical appliances is felt, and it is fully met by the apparatus of Sir William Thomson, Professor of Engineering of the University of Glasgow. This instrument, devised as the recreation of a yachting cruise, is so infinitely superior to anything else of the kind as to put them out of court entirely. It has been materially improved in detail by Lieut. Com. Sigsbee, of the U. S. Navy, but perhaps has reached its fullest development in the form built and used by the I. R. G. P. and Tel. Co. of London.

The fundamental principle of the machine is elimination of friction of the sounding line, which is the great obstacle to the vertical descent of the weight, to receiving warning of the bottom having been reached, and to the recovery of specimens of the ocean's bed.

So long as flax or hemp was used, it was found that, even when reduced to the smallest practical dimensions, the point was speedily reached, when the frictional resistance of its surface would neutralize the gravitation of the heaviest sinker, and that stratified currents swept the line in the most diversified and incalculable sinuosities.

Even the ingenious devices of the late Lieut. Brooke, U. S. N., for detaching the sinker when bottom was reached, thus sparing the line the strain of lifting it to the surface, fail to overcome this trouble. The experiment of dispensing entirely with the line, as in the Morse bathometer, which sinks freely to the bottom, detaches its weight and returns to the surface by its own buoyancy, recording the pressure (and thus, by inference, the depth) it has been subjected to by the amount of mercury forced from one compressible vessel through a minute tube into an incompressible one, only introduced another embarrassment, as the distance and direction of the point of disappearance of the apparatus from the point of its reappearance were, owing to stratified currents, matters of pure chance.

Sir William Thomson secured comparative directness of descent by using small steel wire, which also reduced frictional resistance to a minimum, and obtained unmistakable and instantaneous notice of the bottom having been reached, by keeping the sinker so near its equilibrium that the slightest arrest stopped the running out of the wire.

This is accomplished by accurately balancing with brakes the weight of the wire paid out, and, as bodies falling freely through water are found to very nearly describe equal spaces in equal times, the sinker can do this undisturbed by any increase of weight from the wire paid out. The fact here cited affords an excellent check for indicated soundings.

The accompanying drawing (Fig. 1) shows the essential features of the machine in question.

They consist of a frame bearing a galvanized iron reel, *R*, of steel sounding wire, removable at will from the shaft to which it is keyed. To one side of the reel is attached a grooved brake wheel, *B*, which is enveloped with a cord, whose one end is secured to the frame and the other to the brake lever.

The guide wheel is a decided improvement upon the original machine, which permits it to tread in any direction while paying out or reeling in, with perfect immunity. It and the reel are tangent to the same horizontal, and a bent arm which carries its journals, having an oscillatory motion, athwart the direction of the running wire, allows a vibratory motion in the bearing *J*, at right angles to the reel's plane of revolution, without disturbing this relation. The wheel is counterbalanced (see *C*) with the least possible preponderance, to preserve its verticality, and yields so readily to the slightest pull of the wire, that sounding to a depth of fifty fathoms may be taken from a vessel moving at a considerable speed.

The invention of the brake for balancing the weight of wire paid out is claimed by the writer, and operates in the following manner:

Upon the shaft which bears the reels is a worm which engages with a gear wheel carried by the composite brake lever (shown in plan, Fig. 3).

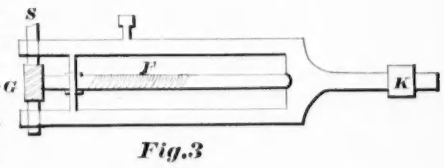


Fig. 3

Revolution of the reel shaft either way causes the screw to turn, but without longitudinal motion in its supports. Riding upon this screw is a weight *W*, made in the form of a hollow box for accurate adjustment, which is accomplished by putting in or taking out shot. It is so shaped as to allow of its coming directly beneath the brake fulcrum, or even passing beyond it, and becoming neutral, or even of contrary effect, if desired. The weight of the steel wire employed for sounding, which is No. 16 B. W. G., and of the class prepared for piano makers, on account of its exceptional tensile strength, is about nine pounds per hundred fathoms, when submerged, and the screw thread is cut and worm wheel proportioned, so as to cause the proper increase of brake leverage needed to exactly balance this regular increment of weight.

Another weight *K* may be observed at the extremity of the brake lever, also capable of adjustment like the traveling weight. This is to balance the constant weight of the sinker. The method of procedure is to place the traveling weight in neutral position, and allowing the sinker (a spindle of cast iron of about thirty pounds weight, with a large enough long passage therein to allow of the specimen cup slipping through it when the sinker is detached) to depend from the reel and, just submerged, to vary the fixed weight *K*, until there is just preponderence

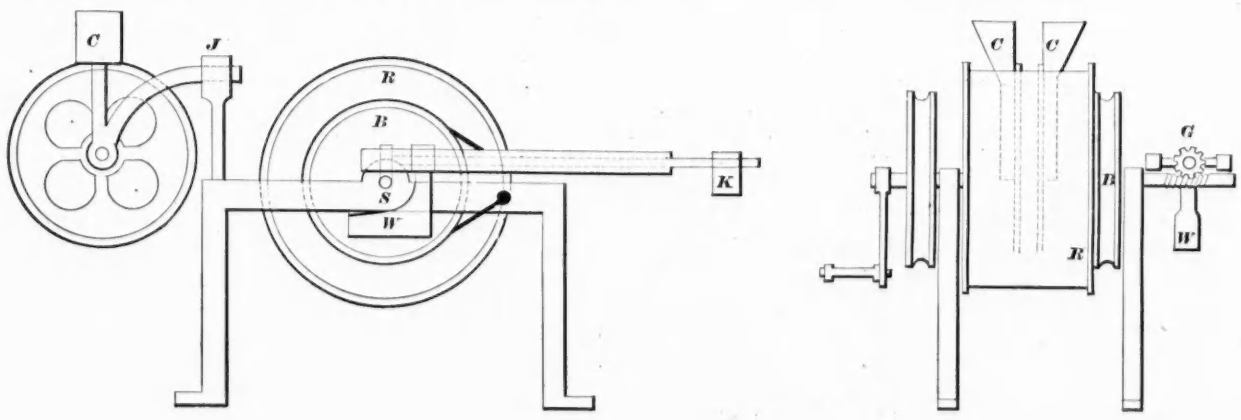


Fig. 1

enough to allow the reel to turn. The varying condition of the journals and lubrication of the machine render this adjustment necessary. The traveling weight preserves this condition very exactly, as the friction of sounding wire is practically *nil*, and the slightest checking of the descent of the sinker instantly stops the reel.

A counter recording the revolutions of the reel then gives the depth.

In Sir William Thomson's original apparatus, the method of balancing the wire paid out by increasing the brake pressure was most elementary, being accomplished by hanging small weights of definite size upon the brake strap at regular intervals of time.

There is nothing peculiar in the detaching device for the sinker in touching bottom, as it has not varied materially from the days of Berryman and Brooke, of the naval service. A very effective and inexpensive specimen cup consists of a cylinder with its upper end closed, with the exception of one or two small perforations, and its lower cover with a diaphragm of rather stiff india rubber, slightly concave externally, and crossed with two diametric cuts at right angles to each other. This perfectly meets the exigencies, which are to have a cup sufficiently mobile to open on touching soft ooze, and yet tight enough to prevent its contents being washed out in the ascent.

The rapidity and accuracy of this machine are illustrated by the soundings taken between Marseilles and Algiers in September, 1879. These average in depth 1,150 fathoms, and were taken in six days, during which the ship ran nearly 700 miles, and for one-third of the time continued work through a mistrale in the Gulf of Lyons, with no greater loss than about seven thousand fathoms of wire, and some twenty-five sinkers and specimen cups. (It is necessary to say at this point that very good authorities prefer to recover the sounding weight at each cast, and this was the practice on the occasion in question.) Samples of bottom were obtained in all cases except two, excluding the occasions when the wire broke. The reeling in was performed by a deck engine, connected to the apparatus by a rope belt. By old methods this work would have occupied a fortnight, while possessing none of the authority and precision of this.

The method of preserving the sounding wire is to keep it in baths of caustic soda, which keep it bright and unoxidized for two or three years.

Each reel of wire, containing four or five thousand fathoms, is used for about twenty-four hours and then returned to its bath, and a fresh reel keyed to the shaft of the machine, which is contrived with a view to facilitating the operation as far as possible.

From the knowledge obtained with this most effective apparatus, the engineer may now prescribe intelligently the proportions of the cable and the quantities of the different types; that is, of the heavy "shore end" in the vicinity of anchorages, the "intermediate" for less exposed localities; and is competent to indicate where special precaution must be taken against chemical destruction of the cable armor by the ocean bed.

This is usually accomplished by covering it with jute, and coating it with a mixture of tar and silica, which also defends it from marine insects; but it is found to be difficult to lay the cable with this covering intact.

The discovery of some alloy not so costly as to exclude it from the list of useful metals, that should show a rate of oxidation notably less than that of iron, yet possessing all its tensile strength and durability, would be the touchstone to commercial success in submarine telegraphy. The conductivity and insulation of submarine wires are all that can be desired; and once safely laid, they are indestructible while the armor lasts, but this failing through corrosion, currents and marine insects work their will in the delicate conductor, which, of itself, is too weak to be lifted to the surface for repair.

Hence, it is a canon of submarine telegraph finance that provision must be made for complete renewal about every twelve years.

The constructing of a profile of the ocean bed from these soundings by the usual method is too familiar a process to be noticed here; but recent experience has established the wisdom of platting it with a common vertical and horizontal scale, for the reason stated below. Of course, this demands something very like an old-fashioned panorama to be at all manageable; but it is not difficult to devise. Cross-section paper of the proper scale can be procured of any length, and, by attaching a common drawing board to a standard bearing rollers at each end, with crank handles, the lengthy diagram can be conveniently used, unrolling it by one crank and rolling it up with the other, the point over which the ship chances to be can always be kept on the drawing board.

The use and convenience of this is readily illustrated.

It is frequently noticed, in laying a telegraph cable, that the velocity with which it leaves the vessel varies decidedly, without corresponding change of the ship's speed, rendering necessary perpetual adjustment of wake power to preserve the ratio of slack which the situation prescribes. By "slack" is meant that excess over the linear distance which is needed to insure the cable's touching ground throughout its path over submarine hills and dales.

It is distasteful to the engineer to waste valuable cable; yet, if the depth is increasing rapidly, it is imperative that the percentum of "slack" be augmented, and *vice versa*.

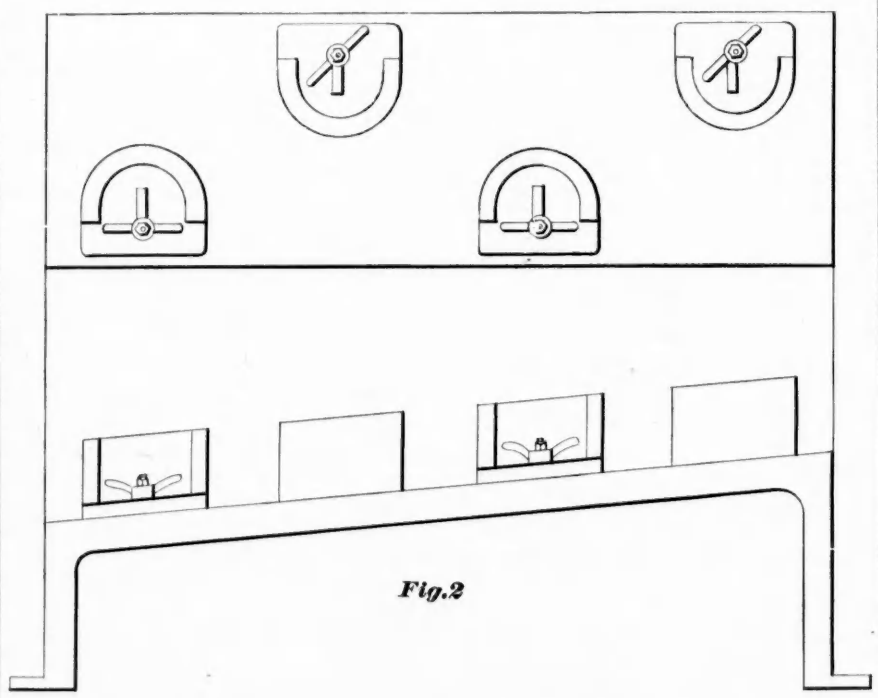


Fig.2

The position of the ship may be readily computed at any moment, but the depth of water at that point by no means measures that at which the cable is "taking ground."

This, in a depth of two thousand fathoms, with the ship moving at six knots per hour, may be four miles astern, and is that to which fluctuations in the speed of outgoing cable are due. Now, the fact already cited that bodies sinking in water assume, after the first two or three seconds, a uniform downward velocity, the direction of a cable between ship and bottom while being laid is approximately a straight line, and an empirical formula given by Latimer Clarke and Heming Jenkin renders it possible to calculate the angle it makes with the surface for any given cable. If, then, a bevel-gauge of suitable dimensions be set at the angle proper to the cable in question, the engineer, by applying it to the true scale profile already described, easily finds the vertical component of the stress which he must control with his brakes. The bevel-gauge cuts the ship's position on the surface and the sounding over the point where it cuts the bottom, measures the downward pull of the cable at the ship's stern.

So, then, when the outgoing cable gathers speed, while the ship maintains steady pace, and there is a doubt whether or not the brakes are not becoming polished and greater force should be applied to them; or, on the contrary, when it passes overboard at slacking rate, and the fear arises that dry brakes or heating journals may be the cause—a recourse to the bevel-gauge and profile will show indubitably that the cable is taking ground later or earlier, and the necessary measures may be taken.

At this point it seems proper to refer to an apparatus which, in combination with the device just described, enables the percentum of slack to be regulated much more accurately than could be done by former methods, even with the closest personal supervision of the engineer, whom it relieves of this most exacting and onerous demand upon his attention.

The old routine was—to order the man stationed at the dynamometer to keep a definite strain upon the outgoing cable which the judgment of the engineer decided to be the proper one, to maintain a uniform ratio between its speed and that of the ship.

The revolutions of the brake drum were taken at regular intervals, more or less close, and compared with the reading of the log, and with a result rarely very satisfactory. The difficulty, also, of keeping the prescribed strain upon the cable by means of the dynamometer was very great in all except the calmest weather. The new instrument, called the stropliometer, consists of a dial in full sight of the man stationed at the dynamometer, connected by a driving belt or cord with the brake drum, the number of whose revolutions per minute are indicated by the points, and evidence of its working given by the sounding of a small bell at each revolution. The normal ship's speed being about one hundred fathoms per minute, and the circumference of the average brake draw about three fathoms, calculation of "slack" frames a question of revolutions which the dynamometer watch can easily maintain as ordered, with the stropliometer appealing instantly to his eye and ear by means of the jockeying which experience teaches him.

One simple but most important change in the paying-out machinery is that in what is termed the "holding-back gear;" otherwise it has only differed in detail from that which Everett designed for the "Niagara," when she assisted at laying the first Atlantic cable.

The submerging cable is controled entirely by the adhesion of several turns of it about a strong drum keyed to the same shaft that carries one or more heavy, wide-faced wheels, against whose circumference wooden blocks are pressed by a belt, which is drawn tight by weights acting through levers. The details are essential here.

A necessary adjunct to this was something to keep a slight pull upon the cable as it took the drum, that the full benefit of its adhesive weight might be insured. This was compassed by letting pass over the cable V-shaped grooves in the peripheries of wheels, whose axles also carried brake wheels of which the tension could be regulated at will.

Other weighted wheels called "jockeys" rode upon the cable, crowding it into the wedge-shaped channel, thus securing the necessary adhesion. Adjustment of these small brakes gave the moderate pull required for this purpose, but it was discovered that in a seaway they become a source of danger.

As the stern of the ship settled in the trough of the sea, the brake-drum would come nearly to a standstill; then, rising with the next wave, would cause it to revolve with extreme rapidity, imparting this motion to the holding-back gear, whose momentum lasted until after the next slacking of the brake-drum, thus causing the cable to pass to it loosely, to the great danger of over-riding or rendering upon it.

The substitute for this is passing the cable between alternate quadrants, adjustable upon a horizontal bed plate, as shown in the sketch (Fig. 2), and it meets every requirement.

The method of landing cable ends from ships depends largely upon the region in which it takes place; but the method now adopted by the I. R. G. P. and Tel. Co., of London, is of almost universal application and worthy of notice. This portion of the work is always done first; the heavy shore end cable and intermediate type being put down at both termini, and buoyed in a depth of water into which the cable ship may safely run. He then splices on the deep sea type at one buoy, and runs for the other.

The ship approaches the land as near as safety warrants, and, having anchored, sends ashore a large spider wheel, so-called, and one or more mushroom anchors. These are buried to a suitable depth, and the spider wheel secured to them in such a manner as to revolve freely.

A line is then passed out over the sheave at the ship's bow (usually a strong grappling rope), carried ashore in boats, rove through the spider wheel, and its end brought back to the ship's stern, where it is made fast to the cable depending from the stern sheave.

The powerful picking-up machine in the fore part of the ship now begins heaving in on the line, and as it comes aboard cable is paid out at the stern of the ship.

It is necessary to sustain the weight of the cable paid out, and this is effected by attaching barrels to it at definite intervals as it goes overboard. While perfectly effective, these are clumsy to handle and most cumbrous on shipboard, and the writer substituted for them at the laying of the Marseilles-Algiers cable of 1879, india rubber spheres of three feet diameter, inflated by a small air pump when needed.

These answered every purpose, were most convenient of manipulation, and were capable of the most compact stowage. This operation can be easily carried on at the distance of a mile from shore, and possibly farther.

The introduction of the electric light is all that remains to be adverted to. This might seem unworthy of notice to one who had not undergone the wearing anxiety of night work on a strong sea in laying submarine telegraphs. The exhausting influence of hour after hour of intense watchfulness, with every sense strained to make good the handicapped eyesight and catch timely warning of aught amiss with the cable tanks; the intricate assemblage of deck machinery and the extensive indications of the electrical test room, is something that must be experienced to be appreciated. The flood of light poured over the deck by electricity lifts half the burden.

The preceding *resumé* has adhered strictly to its title, being little more than a recital of improvements in the methods of submarine telegraph engineering that have been taught by the experience of recent years.

The essentials differ little, if at all, from those adopted in the youth of such enterprises, and is only another proof that the daring spirits who first tied continents together beneath the astonished sea, did not win success by a happy chance.

It was faith, patience, pluck, close thought and hard work, which never fail of their reward. The direction in which farther improvement must be sought is with cables themselves, and not with the methods of building, constructing or laying them. Durability is the great lack, and the promoter of

this, in even a limited degree, cannot fail of a noble reward.

The School of Mechanical Engineering of the Ohio State University, of Columbus, O.

This school did not get a fair start until about three years ago. The institution, of which it forms one department, was endowed by the well-known Act of Congress of 1862. In the winter of 1879 the State of Ohio made an appropriation for a building and its equipment for the above-named school. The result is a building separate from, though near to, the other buildings of the institution. This building contains six rooms, one being a lecture, drawing and recitation room; another being the mechanical museum; another for machinery, benches, vises and tools for working iron cold; another being a forge room; the fifth being a foundry room, and the sixth the pattern making room. The four last named contain the mechanical laboratory. Facilities are also offered for experiments on the University boilers, and on boilers and engines in the city of Columbus.

In the lecture room instruction is given in those principles which form the groundwork of mechanical engineering. The subjects included in this are mechanism; resistance of materials; machinery and mill work; thermodynamics; heat engines; water wheels, etc.

In the mechanical laboratory instruction is imparted by experiments, and by practice in the use of tools. The cold working of iron is by chipping, filing, scraping, turning, planing, milling, drilling, etc., most of the tools of the machine shop being represented. These tools are supplied with power from a compound engine, designed for service in experimentation with the indicator and dynamometer. It stands in the same room. The room contains 13 machine tools, and 16 vises and tool cases.

The forge room has four forges with power blast, and the various appliances for forging. The foundry has a cupola for iron, and a brass furnace; also a moulding floor and sand. The pattern room has eight places for simultaneous work, each with bench, vise and case of tools.

Each student in the practice uses all the tools during the first year, in going over a course of carefully selected practice models. This instruction has for its main object the ready and correct use of tools. Students who desire can go on in an advanced course of construction of machinery.

We are informed that it is not the intention of the conductors of this school to disparage principles to gain practice, nor practice to gain an undue amount of time on principles. Both are essential to the mechanical engineer, as no one will doubt, the only question being as to the proper balancing of them. In this matter we should not forget the proper function of an institution of learning. In short, 1st, it is to better prepare men for subsequent life; 2nd, it should engage mostly in supplying that which is most difficult to gain in the subsequent life, and least likely to be thus gained. Accordingly it is required that students who graduate shall have devoted much more time to principles than to practice. When, however, the student is up to the minimum required in either he may further amplify either as he may desire. Again, without aiming to graduate, he may take either only, or combine them according to his own wish.

Fairbairn Locomotive Gauge Cock.

The gauge cock illustrated herewith resembles very much in general appearance the one described in the AMERICAN MACHINIST of Jan. 29, 1881. It is made by the same concern. This gauge cock, as originally made, had a weight attached to the handle for closing the valve, which, of course, would not work well upon locomotives on account of the violent jolting. The valve in the gauge cock here shown is made the same as the one previously described, being held to its seat by a screw pressing upon a flat spring. But the toothed arc for opening and closing the valve, instead of being continued and terminating in a weighted handle, is fitted to a square shaft, with a wooden wheel

LOCOMOTIVE GAUGE COCK.

attached, to prevent burning the hands in opening and closing the valve. The friction caused by the spring upon the back of the valve is sufficient to hold it in any position. This gauge cock may be cleaned by slacking the screw which presses upon the spring, and turning the handle so as to bring the valve to its lowest position, when a wire may be pushed through a hole in the screw and valve into the boiler. The valve is prevented from being pushed too low by a projection upon the toothed arc.

These gauge cocks have been used upon locomotives for several months past, and are said to work satisfactorily. Where the gauge cocks are within reach of the engineer, some prefer this style to the other style referred to for stationary boilers.

They are made by the New England Gauge Company, 103 Milk Street, Boston, Mass. New York office, 38 Dey Street.

LETTERS FROM PRACTICAL MEN.

The Screw Reduced to a Lever.

Editor American Machinist:

I see in Chordal's valuable letter, in issue of August 20th, a statement that "Every machinist in his early studies quickly tumbles upon an apparent fallacy in this screw business. He unwinds the inclined planes from two screws of the same pitch, and this is what he gets (illustration). These two wedges are exactly what develop from unwrapping the screws shown in Figs. 1 and 2.

"The said inquiring machinist immediately asks if the big screw don't have the most power, using the same lever to turn it, and he points to these two wedges. What is the explanation?"

Now the explanation, to my mind, is that the screw and lever must be considered as one body, a lever which has for its fulcrum the center of the screw, the lever being the long arm and the distance from the center to the outside of the screw answering to the short arm. Then it follows as a natural consequence, that the larger the screw the longer the short arm grows and the less power is applied to the screw; the loss here being exactly proportionate to the power gained by the screw being larger. I think this the correct explanation; if not let some one who is better informed speak. J. W. EASTON.

London, Ontario.

Exceptions to Rules for Tempering Steel.

Editor American Machinist:

On looking over the letters which I have had the temerity to write, and you the kindness to publish, on the subject of steel working, I feel that there are still other assertions to make, and also what might be called disclaimers. I have not, for a moment, supposed that I was competent to teach those who are working steel successfully. From many of them I would gladly receive instruction. In assuming that steel can be annealed, or hardened, at a low, red heat, I am well aware that I am liable to be criticised by amateurs and others, who do not closely observe results, and attempt to follow my instructions. Had it been my intention to lay down any rigid, specific rules as to the heat suitable for all different tempers of steel, without reference to size, the criticism would be appropriate.

My object has been simply to induce more close investigation, feeling satisfied that there is much yet to be learned. Heat, as we speak of it in steel working, is usually judged by color. To different men the same shade of color looks differently. The young man, whose eyes are at their best, sees a color differently from the man who, by reason of his age, is obliged to use glasses, or, worse yet, perhaps, knows that he ought to use them and still rubs along without.

Steel is heated for working, annealing and hardening in all sorts of places, from cellar to attic. In the broad light of day, with the rays of the sun pouring in at doors and windows, and in narrow alleys where the rays of the sun never penetrate, even in basements and cellars where one must grope his way but for artificial light, the steel worker is obliged to decide what is the proper heat. As between these places, what would be red hot in one would seem to be black in another; that which would seem to be just right in one, would, by the dim light of the other, appear to be hopelessly burned. One man will judge of the heat of a piece of steel as it *lies* in the fire, with the glowing fuel as a background, and be surprised, on removing it, to find that what seemed barely red is too hot. Another, especially if the piece of steel be small, will, during the process of heating frequently remove it from the fire and hold it in the shade, if need be, to determine the proper heat. Are not these good reasons why a color card, as has been suggested, would be likely to prove a failure? Again, the difference in heat required by pieces of steel of different size, but of precisely the same quality and temper, is so great, that what might be just right for a large piece in hardening, would utterly ruin a small one; while the exactly proper heat for the small piece would not harden the large one. The heat which might give good results in hardening steel containing any certain percentage of carbon from one manufacturer might prove disastrously high, or not high enough for other steels, owing to difference in material or processes of manufacture, even though the proportion of carbon was the same. Rules for tempering steel should not be too closely followed, either, when it is remembered that the same colors, from a straw color to a light blue, will appear on steel not hardened, or on iron, even, by heating to the requisite heat. One piece of steel may stand at a straw color, equally as well as another at a blue, owing to difference in steel, or, even with the two pieces of steel precisely alike, but hardened at different heats. Too much in relation to steel (which should and may, with a little experimenting on the part of those who use it become generally understood) has been treated as a secret, known to but few; while certain processes and methods have had the credit for all the success attending their use, when the result was simply the inevitable outcome of compliance with laws, which, although unwritten, can not be violated without evidence unmistakable being stamped upon each piece of ill-treated steel.

Pittsburgh, Pa. S. W. GOODYEAR.

Tube Expanding.

Editor American Machinist:

In looking over an August number of your valuable paper, I found under the heading of "Letters from Practical Men," two in relation to Flue Expanding.

Your Washington correspondent illustrates his ideas with a cut of the Dudgeon Roller and a safety sleeve. He says, "It does its work with great efficiency, but becomes a dangerous instrument in the hands of an inexperienced or careless workman." This is something entirely new to me. He also says "it is liable to crack a flue sheet." Now I am a pretty muscular man, and with a twenty-inch steel pin in length and three-quarters of an inch in diameter, placed in mandrel of the Dudgeon roller, and driven in tight, it often happened I would bend the lever in operating the tool, but in no case have I ever cracked a tube sheet *if the holes were round.* In regard to the sleeve, I think it of very little practical value, as it is well known that in fire boxes or furnaces running for several months the flue holes get out of round, especially on the sides and top of fire box; and where the water is bad and the flues leak in the center, these become larger from repairing; and so with a boiler with nearly two hundred flues, and the holes varying as I have stated, the operator would want a half bushel of different sized sleeves to complete it, and a good deal of valuable time would be taken up in changing the sleeves. Perhaps Uncle Sam could stand the loss of time, but corporations and boss boiler makers would hardly consent to it.

Your correspondent Quirk, of Chattanooga, tells what he knows about Flue Expanding, and has given two cuts representing tubes set by both the Prosser Expander and Dudgeon Roller. Fig. 2, representing the impression made on inside and outside of tube sheet, is far from correct, as *there can be no shoulder made on the inside* of a tube sheet with the dudgeon roller, from the fact that the mandrel is tapered $\frac{1}{16}$ to the inch, and the rollers are *perfectly straight.* If flues are set in flue sheet as shown in Fig. 2, with the dudgeon tool, why is it that I can back out *through its own hole without splitting,* every flue in a locomotive boiler, with the hammer in one hand, using the other to hold something else against the end of the flue? I would ask again, how often does it happen that flues in the fire-box end wear off from fire, or in repairing become level with sheet, or collapse from lime or sediment and burn through, necessitating driving plugs in them? In nine cases out of ten you will, in this operation, drive the flue out of the hole, and either incur the danger of being scalded with steam, or driven out in double quick to avoid a ducking.

These are facts, and any one can satisfy himself by taking a 4-inch square piece of iron $\frac{1}{2}$ inch thick, drilling a 2-inch hole in it, putting in a piece of 2-inch tube, and expanding it with the dudgeon roller. Take it to the planer and cut it in two, and it will show for itself.

Countersinking the sheet I think is quite important, at least taking the sharp edges off both inside and outside, as in using light copper ferrules it is likely to cut them.

In regard to beading flues, my experience has been that a bead, say $\frac{1}{8}$ of an inch is best, and much less work to turn over. A long bead takes too much hammering, which destroys the nature of the iron and makes it spongy; it is more liable to rise up and burn, and gets loose quicker.

There are so many points to cover in tube expanding that it is hard to be brief, but I will leave the subject until some future time, and will watch the correspondence with interest.

PRACTICAL BOILERMAKER.

Bloomington, Ills.

Screw Cutting.

Editor American Machinist:

The rule given by "Short Cut," in your issue of September 10th is one of the best that I have seen published; but for cutting the screws most in demand there is still a "shorter cut."

Instead of multiplying by any convenient number, use the number that the change gears increase by, which on "Short Cut's" lathe is 7. This will give, without further trial, gears to cut any screw from 4 to 16 inclusive (on his lathe), and the gear on stud need not be changed.

Outside of these, the "convenient number" may be used, which isn't so very convenient after all, as it must generally be $\frac{1}{2}$ or $\frac{1}{4}$ of 7, which being borne in mind may save some experimenting.

GREASER,

Boston, Mass.

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NEW YORK, SEPTEMBER 17, 1881.

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A Good Year for Industrial Exhibitions.

The enthusiasm of the people of this country over industrial exhibitions, which alone insures their success, follows no known rule, except that it cannot be maintained at its maximum two or three years in succession. There are good years and bad years for great fairs, just as there are for the crops. This year seems to be a good one for industrial displays; last year was not. The unusual activity in most kinds of business, particularly in the metal and building trades, has a favorable influence on the attendance at the fairs, while it acts as a drawback upon the entering of articles for public display. Manufacturers who are crowded with orders beyond their present ability to execute are naturally reluctant to send some of their best products to an exhibition, thus placing them beyond their reach, as far as the requirements of customers are concerned, for a period of one to three months. Yet of those who have taken pains to be properly represented at these exhibitions in the past, very few express any regrets, in consequence. No manufacturer can expect to attract anywhere near the number of interested spectators to his shop, or warerooms, that may be depended upon to view his productions at a live industrial exhibition.

The principal fair this year will be the International Cotton Exposition at Atlanta, from October 5th to January 1st. The original idea, as implied in its name, was to confine the exhibition to processes and appurtenances in the production and manufacture of cotton. The managers, however, seem to have discovered, as preparations progressed, that the field entered upon is more extensive than at first anticipated. They have therefore concluded to admit exhibits of every description. So favorably has this enterprise been received that applications for space have already been allowed, requiring more room than the buildings thus far projected will contain. Other buildings must therefore be erected, and the managers have limited the time for receiving applications to September 10th. The fact that an industrial exhibition of such a character can successfully be held in the South (a project which three or four years ago would hardly have been seriously considered), indicates a kind of national progress of which we may justly feel proud.

With annual industrial fairs Boston this year takes the lead. That of the New England Manufacturers' and Mechanics' Institute, which opened August 18th, and that of the Massachusetts Charitable Mechanic Association, which opened Sept. 1st, both in large new buildings erected specially for the purpose of annual fairs, are now in operation. These two exhibitions manifest considerable rivalry, and are therefore doing their best to entertain and benefit visitors. They are both mechanical fairs, and will receive particular attention in our columns.

In New York City the Semi-Centennial Exhibition of the American Institute opens September 14th, but the date of closing is not announced. This is the oldest regular annual fair in the United States, is always well attended, and is the most profuse in the distribution of awards to exhibitors. This year silver medals will be given for the same class of awards heretofore dismissed with bronze medals.

Cincinnati holds her ninth industrial exposition from September 7th to October 8th. The prospects are said to be excellent. The Inter-State Industrial Exhibition of Chicago is also announced to occur in October. The Mechanics' Fair of San Francisco is now in progress. Some other cities will hold fairs this fall. As this is a booming year for exhibitions, we advise all to visit them who can do so.

Industrial Common-School Education.

It is agreed upon all hands that there is a lack of proper industrial education for the rising generation. There are schools enough, but very few of them afford any technical training. Some of the philosophers of our exchanges, prompt to suggest a plan to meet the requirements, have been urging the importance of combining industrial tuition with the ordinary branches taught in our common schools. They contend that practical mechanical operations should be carried on in connection with the public schools, in order that pupils shall be at an early age initiated into the special manipulations of the industrial arts. We were not aware that their progressive ideas had been put to the test of actual practice, until one day last week, while strolling at the foot of Blue Mountain, in the Adirondacks, we came across an establishment that fulfills the ideal plans of our philosophical contemporaries.

It was a public school and a saw mill combined—the former in a loft over the latter. The educational part of the establishment was in full operation at the time of our visit, but the industrial part was idle, owing to a scarcity of water in the mountain stream that supplies the motive power. When the stream is swollen by copious rains and the hum of the buzz saw in the industrial department unites with the buzz of the active youth in the educational department, the full fruition of the new plan of instruction may be expected.

Seriously considered, however, it is doubtful whether it would prove successful to require or encourage pupils in public schools to study industrial arts in connection with the universal elementary branches to which they are accustomed to devote their school hours. The ordinary course of instruction for children embraces too much rather than too little, besides which the industrial arts are too numerous to admit of being satisfactorily taught in the district schools. Good mechanics are made—first by obtaining a general education, and then by serving an apprenticeship to a trade.

Mechanical and Educational Co-relation.

There is a certain co-relation of mechanical needs, and mechanical skill and appliances, that makes it at times difficult to determine which is entitled to the credit for advances made in any specific direction. Chordal's miller, who required a better proof staff, had a good deal to do with educating Chordal up to the making of one that would answer the requirements; while, on the other hand, the fact that the skill to make something nearly perfect existed, undoubtedly, had quite as much to do with the miller's demand. Neither may have had much interest, or at least more than a selfish interest in supplying the wants of the one or advancing the other in the way of skill; notwithstanding which the relation between something better wanted, and the latent ability to produce it brought about better results both in the direction of milling, and the manufacture of milling tools. This is only one illustration of the interworking of things not particularly related, to bring about results common to both. It is interesting to note this co-relation in its influence on the great manufacturing interests of the country. The builders of steam engines, or of machine tools, or in fact of any kind of machines and machinery, are supplying refined products because they are called for, and they are called for because the skill to produce them exists or will be forthcoming. There is a sympathy between the want and the filling of it that is imperfectly accounted for by the law of supply and demand.

It might at first thought seem improbable that there was any relation between the character of the products of a cotton mill, in Lowell, for instance, and the manufacture of standard gauges and measuring instruments of perfection in Providence or Wilmington; but the fact is—the progress of the one is intimately associated with that of the other. This relation may not be altogether clearly defined, but it exists none the less, because it cannot be so readily traced or defined. The fact that such gauges and such instruments can be made, has much to do with the mechanical system and order and perfection of the mill, and that system and order and perfection make it possible to improve the quality of the productions, and to manufacture so cheaply as to insure a demand. In return, the want of such a system has quite as much to do with the production of the tools and mechanical refinements which render it possible. In this way the desire of some one who don't know what a standard gauge is like has an influence in determining their production, while those who think they have no interest in the manufacture of cotton exert a good deal of influence in the institution, the improvements, and the refinements of that business.

While, as may be seen, the extent of the individual's influence, referred to distance, may not be circumscribed, the effect is more noticeable when considered in its relation to different industries in the same localities. In this respect it will be seen that the establishment of one industry leads to the establishment, not only of others of the same kind, but to those so entirely different that it is difficult to trace a possible connection between them. It may also be seen that, as the establishment of the one assists the others in gaining a foothold, so the progress towards perfection of either lifts the others upward and in the same direction.

While, as has been said, these effects result where there is no apparent connection, and even where there might be supposed to be an actual antagonism, it is nevertheless certain that there must be a real cause without which there is no effect.

It is coming to be better understood that this cause is knowledge; not exactly special, or in a specific direction, but a general fund towards which all contribute, and from which all may draw. It is noticeable, in this connection, how the appreciation of this fact breaks down the barriers of trade-secrets, and determines all to contribute to the general fund. Thus it is that the members of an intelligent community mutually help each other, and help along the general and special business prospects. A more perfect understanding of mechanical and educational co-relation will rob business pursuits of the exceptional part of their selfishness, because it shows conclusively that knowledge and education in an entire community tend to advance any single individual member.

It is one of the healthiest signs of the times, that it is getting to be conceded that the proper advancement of even a special interest depends largely upon the general intelligence of all, and that, even in a purely selfish view, the best use to make of knowledge is to spread it as much as possible.

We present in this issue the sixth article on Mechanical Drawing, by Prof. John E. Sweet. The others of the series appeared in our issues of July 16th and 23d, and August 6th, 13th and 27th. These articles are being widely read and appreciated. All or any of the numbers of the AMERICAN MACHINIST containing them can be obtained through any regular newsdealer.

Literary Notes.

HAND-BOOK OF USEFUL TABLES FOR THE LUMBERMAN, FARMER AND MECHANIC. Tables of Interest, Board or Rent per week. Board and Timber Measure, etc. 176 printed pages. Published by Finch & Apgar, Ithaca, N. Y. Price, bound, 25 cents.

This little book was prepared by a competent mathematician and graduate of the Cornell University, which ought to be a sufficient guarantee for the correctness of the tables contained. These are particularly useful to the business man, and, having been arranged with good judgment, are very practical for consultation at a moment's notice.

MANUAL OF THE RAILROADS OF THE UNITED STATES FOR 1881, showing their mileage, stocks, bonds, cost, traffic earnings, expenses and organizations, with a sketch of their rise, progress, influence, etc.; together with an appendix containing a full analysis of the debts of the United States and of the several States. By Henry V. Poor. H. V. & H. W. Poor, New York. Price, $5.00.

This well-known annual publication, the title of which, given above in full, indicates the character of its contents, is compiled in the present issue with the usual care, and all information is brought down to a late date. The work contains over 900 pages, and is almost indispensable to any one desiring to keep informed upon railway matters.

QUESTIONS & ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.

(1) Z. C. S., Greenpoint, N. Y., writes: I am in charge of an engine, and when it was erected the outboard pillow block was set 11″ from the end of the shaft, and so there is a key-way in the journal, which, I think, accounts for the fact that the crank wheel runs out of truth, and with an irregular motion. I am going to move the pillow block to the end of the shaft. Will you please give me some directions how to proceed, so as to get the shaft square with the engine? *A.* Remove the piston, and stretch a line through the cylinder, making the end fast to something beyond the crank shaft. Set this line exactly central by the counterbore at the outer end of the cylinder, and by the bore of the stuffing box at the inner end. Set the outboard pillow block presumably right, and clamp it so that it will not move. Turn the shaft in either direction till the pin comes to the line, and measure accurately the distance from either shoulder of the pin to the line. Turn the shaft in the other direction till the pin comes to the line, and measure as before from the same shoulder to the line. If the two measures agree, the shaft is square with the bore of the cylinder. It is also necessary to set the crank shaft in line with the cross-head pin. For this purpose drop a plumb line from the floor overhead, and so that it shall hang one-half the diameter of the crank pin back of the center of the crank shaft, and anywhere between the shoulders of the crank pin (for convenience of measuring). Turn the shaft so the crank pin is directly up, and measure from the shoulder to the line, and also turn it so the pin is down and measure the same. Raise or lower the outboard pillow block until the two measures agree. Of course this is on the supposition that the cross-head pin is square with a plumb line—in other words, that it is level. This can be determined in various ways, according to the peculiar construction of the engine—as by an accurate level on the slides, or by a straight edge set vertically and compared with a plumb line, etc. If, however, the cross-head pin is not square with the plumb line, and it is not thought best to level up the bed, accurately measure how much it is out of square, and make an equal allowance when setting the shaft by the plumb line. We do not think the trouble with the crank wheel is caused entirely by the key-way in the journal, although it is a poor place for one.

(2) H. W., Port Detroit, Mich., writes: I did not correctly state the question (answered Aug. 6) in reference to burning shavings. I have a furnace, and take the shavings through a 7″ pipe from each mill, and blow them with a fan into the furnace, through a 14″ pipe, but cannot burn them. How can I change it so as to do so? *A.* We do not believe you will succeed in that way. You undoubtedly blow in with the shavings so much air that it cools your fire too much. We should rebuild the furnace so as to feed as indicated in our previous answer, and then bring the shavings from the mill in the pipes as at present, and feed them in as indicated. If the draft is not strong enough, you can use the blower to blow the air under the grate.

(3) T. K., Dover, Del., writes us that he is 17½ years old, is anxious to learn mechanical engineering, and asks our advice as to whether he had better take the course of an institute devoted to teaching this science, or go into a machine shop as an apprentice? *A.* We advise you by all means to take the shop course, and if you are able to do so take the institute course also. Which you take first should depend on your inclination in the matter. If you have none, our advice would be the shop course first, and the institute course later.

(4) H. P., Laurium, Greece, writes: All our locomotives are made in France. They have hollow cast steel pistons, 3⅜″ thick. Can we replace them with cast iron ones of the same thickness? *A.* Yes. We suppose the pistons are made of steel to secure lightness. If you make them of cast iron they will be somewhat heavier, which may not be objectionable. 2. How can I temper steel springs for locomotives and cars? *A.* To make a good leaf spring, such as you refer to, is a job requiring skill and practice. In tempering they should be heated in a furnace and hardened in oil, and blazed off in the usual manner.

(5) M. E. K., Danville, N. Y., asks: Please answer through your paper the following questions: 1. How can I find the horse power of a steam engine? *A.* See rule on third page of AMERICAN MACHINIST, issue of May 14, 1881; also answer to H. S. H., issue of May 28, 1881. 2. Send me full directions for running a stationary engine and boiler? *A.* Apprentice yourself in some way to a party who has a stationary engine to run, and some one to run it and teach you.

(6) A. D., Ottumwa, Iowa, writes: I enclose sketch of two girders, one with the web below and the other with the web above the plate. Which will be the strongest? (Our correspondent's sketches show two round head arch plates, with span of 16 feet 10″.) *A.* We do not believe there would be any material difference in the strength of the two girders, since, if securely fastened, they must give way by shearing, previous to which all parts of the girder would be in compression.

(7) W. E. C., Waterbury, Conn., asks: 1. Can you tell me what is used to clean waste? *A.* It is cleansed by boiling with an alkali; as a solution of soda ash, or caustic soda, or potash in water. It has not generally been found profitable. 2. Did you ever know of bi-sulphide of carbon being used for the purpose? *A.* No.

(8) H. S., Allegheny, Pa., writes: A friend of mine claims that there is nothing that can cut off the attraction between two magnets. I claim that glass will. Which is right? *A.* No substance except it contains iron will cut off or obstruct the attraction of a magnet.

(9) A. H. G., Dubuque, Iowa, writes: In your issue of August 27, a correspondent recommends the use of refined coal oil in boilers. Is it the same as kerosene or burning oil? *A.* Yes, it is the same as the best quality of kerosene. It is materially different from much stuff that is sold as kerosene, however.

(10) E. H., New York City, asks how he shall show in a drawing the depth of a circle of the teeth of a worm wheel. *A.* We think you will find the information you want in an article by Herman T. C. Kraus, in AMERICAN MACHINIST of February 7, 1880.

(11) W. H. F., Peterboro, Ontario, asks how to make the solution used for copying by the blue process. *A.* See answer to E. A. M., in AMERICAN MACHINIST of July 3, 1880.

BUSINESS SPECIALS.

50 cts. a line for each insertion under this head.

Alden Crushers. Westinghouse Mach. Co., Pittsburgh, Pa.

Complete set of fittings for Maschmeyer's T-Square as illustrated in AMERICAN MACHINIST Aug. 27, sent by mail on receipt of $3.00. Lewis G. Carr, 2227 Trenton Avenue, Philadelphia.

Presses & Dies. Ferracute Mach. Co., Bridgeton, N.J.

Foot Power Machinery, for workshop use, sent on trial if desired. W. F. & John Barnes, Rockford, Ill.

James W. See, Consulting Engineer, Hamilton, O.

"Paragon" Metallic Piston Rod Packing. See AMERICAN MACHINIST, July 16th, 1881. Write for prices. A. Wilkinson, Manayunk, Philadelphia, Pa.

Special inducements offered to clubs. "Extracts from Chordal's Letters" in book form, now ready. Cloth. 320 pages. Less than 5 copies, $1.50 by mail, each, postpaid. American Machinist Publishing Company, 96 Fulton Street, New York.

A New Treatise on Steam Engineering, Physical Properties of Permanent Gases and of Different Kinds of Vapor. By John W. Nystrom, C. E., 8vo., cloth. Price, $1.50, also A New Treatise on the Elements of Mechanics, Establishing Strict Precision in the Meaning of Dynamical Terms. By John W. Nystrom, C. E., 8vo., cloth, price. $2.00, Mailed by E. & F. N. Spon. 446 Broome St., New York City, on receipt of price.

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Latest and best books on Steam Engineering. Send stamp for Catalogue. F. Keppy, Bridgeport, Ct.

MANUFACTURES.

S. Adams & Son, Rome, N. Y., manufacturers of agricultural implements, are increasing their facilities for manufacturing, more than 30 per cent.

The Harvey Manufacturing Company, of Falls Village, Conn., expect soon to be able to turn out 14,000 bolts each day.

Watts, Campbell & Co., Newark, N. J., are extremely busy with orders for their improved Corliss engines, and for general machinery.

The Ames Manufacturing Company, Chicopee, Mass., are filling an order for fifty thousand Eldredge sewing machines.

The Buckeye Engine Company, Salem, Ohio, will furnish a 150 horse-power engine for the Brush electric lights at the Chicago Exposition.

John T. Noye & Sons, Buffalo, N. Y., are busy building the Stevens roller mill, which seems to be gradually crowding mill stones out of use.

It is said that when the mill now being built by Brown, Bonnell & Co., at Youngstown, Ohio, is completed, it will be the largest merchant iron manufacturing establishment in the United States.

The Pratt & Whitney Company, of Hartford, Conn., are filling an order for machine tools from Shanghai, China; also orders from Germany for forging machinery.

The Providence Tool Company, Providence, R. I., are building 100 of the "Household" sewing machines per day, and will extend their facilities so as to double the production. This machine has been on the market but one year.

The Nicholson File Company, Providence, R. I., are building extensive additions to their shops, being driven to provide more room by an increasing press of orders. They will drive the machinery of the new shops with an 80 horse-power Harris-Corliss engine.

The Lehigh Valley Emery Wheel Co., Lehighton, Pa., have begun the manufacture of T. Hodgson's (Amherst, Nova Scotia) saw gummer and sharpener, described in our issue of August 13.

At a recent meeting of the stockholders of the Carbon Rolling Mill Co., Limited, at their office at Mauch Chunk, Pa., it was decided to again start up their works at Weissport, Pa., which have been lying idle for the past six months. They expect to be ready to commence work by the 1st proximo, and will employ about fifty men.

The Ashcroft Manufacturing Co., No. 111 Liberty Street, New York, have just received an order for 384 gauges for export: 72 were 8½″, brass case, and 96 were 6¾″, brass balance, assorted sizes. Also an order from Geo. H. Barrus, Consulting Engineer, Boston, for a pair of Tabor indicators for his own use.

Davis & Furber, North Andover, are erecting a new brick building, 202x50 feet, three stories high, built of brick, for the manufacture of cards and general machinery; they are also preparing to build a new blacksmith shop. This concern is doing a very large business, and have plenty of orders on hand.—*Boston Commercial Bulletin.*

A. Aller, 109 Liberty St., New York, agent for the Craig Steam Engine Governor will exhibit that article at the American Institute Fair this fall. He is very anxious to get up a competitive test with some other governor according to the plan advocated in the AMERICAN MACHINIST. We commend the matter to the manufacturers of governors and to the managers of the Fair.

The Buckeye Engine Company have booked orders for 98 engines from January 1st to the present time, and the Hartford Engineering Company as many more, in proportion to the time they have been organized for business. The latter company are now shipping about six engines a month, averaging 18 inches diameter, and when their full plant of tools are received they will turn out twelve per month. The total output of Buckeye engines from these two concerns will approximate two hundred and fifty this year.

The Hartford Engineering Co., Hartford, Conn., are to furnish a high-speed engine for the electric lights in the New York Post Office. The new engine is to be 12″x21″, and is to run at 200 revolutions. It is to do the work now being done by a low-speed engine 16″x30″ which is run at 80 revolutions. They will also furnish the engine for the Brush electric lights at the fair of the American Institute. In addition to the Hartford Buckeye engine, they are exhibiting a Buzzell patent boiler and wrought rim pulleys at the fair of the New England Manufacturers' and Mechanics' Institute.

The Davidson Steam Pump Company, Brooklyn, N. Y., have recently completed and tested at their works a compound steam pump with independent jet condenser, for the Conglomerate Mining Company of Lake Superior. The steam cylinders are set tandem, with separate piston rods, and the water cylinder has a capacity of two million gallons in twenty-four hours at a piston speed of 100 feet. It was satisfactorily tested while standing on the floor in the shop. The Company have orders for five more of these pumps of the same capacity.

The Lehigh Stove and Manufacturing Co., of Lehighton, Pa., who, for the past two years have been doing only a general foundry business, have again commenced the manufacture of their well known line of stoves, ranges, etc., all of which have been greatly improved. They have also added to their plant considerable new machinery, prominent among which is one of the Lehigh Valley Emery Wheel Co.'s new Stove-Plate Grinders. This grinder has only recently been placed on the market, and it is meeting with universal approval by the many who have tried it.

Frick & Co., of the Waynesboro (Pa.) Engine Works, have moved to their handsome office at the new works. The office is built of brick, has a basement, over which is the first story, consisting of reception room, superintendent's, draughtsman's, correspondents', collectors', and bookkeeper's offices. The second story is a repository, the whole structure being surmounted by an observatory. They have lately shipped one of their pumps to Amsterdam, Holland. They have a large plant of pumps and condensing apparatus *en route* to Mexico. Have lately shipped a large plant to Callao, Peru; one to Halifax, N. S., and several to Havana.

Newly Incorporated Companies.

MASSACHUSETTS.

Texas Construction Company, Boston; Dana Sargent, Pres., Edward D. Newins, Treas.; Capital, $1,000,000. To make surveys, plans and estimates of cost of a railroad or railroads in Texas or elsewhere, and to make contracts for performing, the labor in, and furnishing the materials for the construction of the whole or any part of such road, and the equipment thereof, with authority to subscribe for, take, hold and own bonds, stock and other securities in such railroad or railroads.

ILLINOIS.

Danville and East St. Louis Railroad Company; principal office, Danville; H. W. Beckwith, Peter Wilber, T. H. Myers, Chas. J. Palmer and Will H. Beckwith, corporators; Capital stock, $5,000,000. To construct and operate a line of railroad, commencing at or near the city of Danville, in Vermillion County, Illinois, and run thence southwestwardly by the most practicable route to the city of East St. Louis, in the same State.

Matuska and Craig Furniture Company, Chicago; Anton Matuska, James A. Craig and Frank Steiskal, corporators; Capital, $25,000. For the manufacture and sale of furniture.

The Tower Grain Dryer Manufacturing Company, Chicago; John G. Roberts, James G. Cozzens and Joshua S. Stevens, corporators; Capital, $200,000. To manufacture and operate machines for the purpose of drying grain, malt, etc.

Absolute Milling and Mining Company, Chicago; W. K. Everson, F. A. Barnard and J. D. Weber, corporators; Capital, $700,000. For the manufacture of metals, milling, refining, reducing, etc.

Germicide Company of Illinois, Chicago; Henry F. Billings, Edwin Maynard and C. L. Cohn, corporators; Capital, $150,000. For the manufacture, sale and leasing of Germicides and disinfectants.

The National Rotary Plow Co.; location, Chicago Alexander Austin, John Austin and Joseph J. Hall, corporators; Capital, $20,000. For the manufacture and sale of the National Rotary Plow and other agricultural implements.

The Blount Barrel Machine Co.; location, Chicago; Alexander C. Blount, Thos. H. Martin and Hugh M. Miller, corporators; Capital, $100,000. For the manufacture and sale of barrels, hogsheads, casks, and other similar packages.

Midland Telephone Company; location, Chicago; W. S. Chapman, L. J. Amsden and John R. James, corporators; Capital, $1,000,000. To manufacture and sell telephones and all apparatus connected therewith; to construct, lease and purchase, own and operate telephones, telephone exchanges, and telegraph lines.

Grape and Cane Sugar Refinery Company; location, Chicago; William D. Friend, P. A. Palmer and J. N. Chilton, corporators; Capital, $2,000,000. To manufacture and sell a new product composed of grape and cane sugar.

Springfield and St. Louis Railroad Company; principal office, Litchfield, Montgomery Co.; E. B. McClure, H. H. Beach, D. T. McIntyre, E. Southworth, C. C. Brown and Geo. A. Black, corporators; capital, $1,000,000. To construct and operate a line of railroad, with one or more tracks, commencing at the City of Springfield, and extending from thence upon the most practical route to the City of East St. Louis, in the State of Illinois.

The Star Coal Company of Streator; location, Streator; Wm. H. Halcomb G. M. Hunt and Isaac N. Perry, corporators; Capital, $75,000. For manufacturing and mining purposes.

Knoxville Zinc Works; location, Chicago; Jacob Heissler, E. R. Lott and Wm. H. Long, corporators; Capital, $120,000. To manufacture and sell all articles made of or from metals, to mine ores and coal, to treat and reduce ores, and erect or purchase smelting works, also works for the manufacture of metals, furnaces and rolling mills.

The French Soap Manufacturing Company; location, Chicago; Geo. H. Welton, Joshua W. Carr and Julius Sterner, corporators; Capital, $250,000. To manufacture, sell and purchase soaps, soap material and machinery appertaining thereto.

NEW YORK.

The Le Claude Battery Company, New York; Cornelius Roosevelt, Hilbourne L. Roosevelt and Horatio J. Brewer, incorporators; Capital, $5,000. To manufacture and sell electrical apparatus.

The Long-distance Electric Call Company, New York; James N. Jameson, Wm. C. Lockwood, James Brady and Alfred P. W. Seaman, incorporators; Capital, $50,000. To manufacture, operate, furnish, rent and sell machines, instruments and appliances for use in transmitting telegraph or electric calls, signals and electrical communications of every description and kind whatsoever, also in the production of electrical illuminations.

Humane Live Stock Express Company, New York; Wm. B. Sipes, Stephen W. Sears, Alfred D. Tingley and Elisha W. Andrews, corporators; Capital, $5,000,000. To manufacture, operate, sell, lease, or license improved apparatus for feeding and watering live stock on railroad trains, steamboats, and all other modes of conveyance without unloading them, and to do a general express business in live stock.

South Ferry and Sea Side Direct Transit Company. Directors: Thos. E. Davis, W. Stunnard Wood, Wm. Redmond, Chas. A. Minton, Oliver Fiske, Chas. S. Brown, H. J. Cullen, Jr., H. E. Gawtry, Phillip Allen, Wm. B. Schermerhorn, Jas. B. Toler, C. A. Grymes and Lewis A. Brown; Capital, $1,000,000. To construct, maintain, and operate a railroad, commencing under Atlantic Avenue, in the City of Brooklyn, near South Ferry, and extending under various streets in the City of Brooklyn to the township of New Utrecht, thence to Coney Island Creek and Sheepshead Bay, across Plumb and Barren Islands to Rockaway Inlet. Length of road twenty miles.

The New York Turning Company, New York; W. C. Andrews, C. C. Peck and R. E. Rockwell, corporators; Capital, $25,000. To manufacture and vend wood turned in various forms, also to make and sell machines for doing such work.

The International Ozone and Manufacturing Company, New York; Lewis M. Slocum, W. M. Burdick, Lemuel H. Wilson, Edgar Smith, A. D. Vinton and John Hagan, corporators; Capital, $7,000,000. To manufacture purified chemicals and ozone, and generators and preserving machines for the same.

Utica Furniture Company, Limited: Peter Vidouard, John Bosler, Eli Overton, and others, corporaters; Capital, $20,000. For the manufacture and sale of furniture.

Machinists' and Engineers' Supplies.

NEW YORK, Sept. 1, 1881.

W. P. Davis, North Bloomfield, N.Y., has issued a new catalogue and price list of his key-seating machines, upright drill presses, lathes, apple grinders, etc.

The Betts Machine Co., Wilmington, Del., issue a 70 page illustrated catalogue of their machine tools and appliances. Every article is plainly described. This company has put forth a great deal of persistent effort to persuade American machine shops to adopt a system of accurate measurements in their ordinary every-day practice. A list of leading firms and companies supplied with the measuring and gauging implements, covering four pages of the catalogue, presents evidence of the success of their efforts. The "Wilmington Caliper" and the "lot of collars strung on a bar," exhibited to Wyckoff, by Chordal, some months ago, form part of their gauge system. Their machine tools are of new and improved designs.

The U. S. Mineral Wool Co., 16 Courtlandt St., New York, are distributing, neatly done up in small paper boxes, specimens of their mineral wool, which is highly recommended as a covering for steam boilers, pipes, etc., as a lining for refrigerators, as a deadener of sound under floors, and for a great variety of useful purposes.

Iron and Metal Review.

Demand for pig iron is good, and seems to increase every week. Market is firm and buoyant at $25 for No. 1 Foundry; $22 to $22.50 for No 2 Foundry, and $21 for Grey Forge. Scotch Pig is also more active. We quote Coltness, $23.50 to $24, Eglinton, $21; Glengarnock and Gartsherrie, $23. The rail trade is brisk at $60 to $63 for steel for early delivery, and $56 to $60 for next year's delivery. Iron rails sell at $48 to $49. Old T rails command $27 to $28, and double heads, $30. Wrought scrap iron sells at $29 to $30 for No. 1 at yard. The metal market is strong and active. Ingot Copper is worth 17c; Straits Tin, 21c. to 21¼c.; Australian Tin, 21¾c.; Billiton Tin, 21c; Common Lead, 5c.; Refined Lead, 5¼c.; Western Spelter, 5¼c.; Silesian Spelter, 5¾c.; Sheet Zinc, 7c.; Antimony, 14¼c. to 14½c.

WANTED

Wanted—By Phœnix Foundry and Machine Co., Syracuse, N. Y., a man qualified to take charge of a boiler shop. Must be well recommended. Steady employment and good pay to the right man.

A thoroughly competent and experienced steam engineer wants a situation of responsibility, with compensation corresponding to the degree of service rendered. Can furnish every required evidence of ability and reliability. Address, "Chief Engineer," office AMERICAN MACHINIST.

Engagement as assistant draughtsman wanted. Five years' experience. Good theoretical and practical knowledge. Best references. Address Box 2, AMERICAN MACHINIST.

Wanted.—To buy a good second-hand automatic or adjustable cut-off engine, about 12x18. E. W. Thompson, AMERICAN MACHINIST office, New York.

Wanted.—A position as master mechanic or foreman of railroad repair shop, by a man of 24 years' experience; 10 years as foreman Best of references. Address Box 11, AMERICAN MACHINIST.

Mechanical draughtsman and designer desires position. Scientific graduate of several years' standing, and fully competent. Address Box 8, AMERICAN MACHINIST, New York.

Wanted.—A partner in a boiler shop. No objection to an active business man instead of a boiler maker. Address J. J. Duffy, Waterbury, Conn.

By a good Pattern Maker a permanent situation. He has had a large experience in Hardware Work; can work metal or wood; is strictly temperate and moral. The best of references given if desired. Address, Box 315, Norwich, Conn.

A first-class tool maker who has had charge of a tool room for the past eight years would like a similar position. The West preferred. Best references given. Address Frank, Box 406, Waterbury, Ct.

Position as Superintendent by a well-known and experienced Machinist and Designer, who is now occupying a similar position. Established reputation and first-class references. Address, SUPERINTENDENT, AMERICAN MACHINIST Office, Box 14.

HOW

To Keep Boilers Clean,

and other valuable information for Steam Users and Engineers. Book of sixty-four pages. Published by **JAS. F. HOTCHKISS, 84 John St., New York.** Mailed free to any address.

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A MACHINE AND LAMP COMPLETE for *Two Hundred Dollars.* Gives one light rated at 2,500 candles. In other words will light a space 150 feet square so that this advertisement can be read easily. Requires about 1½ horse power. Only ordinary intelligence required to run it. Full instructions with each machine. Send for Circular.

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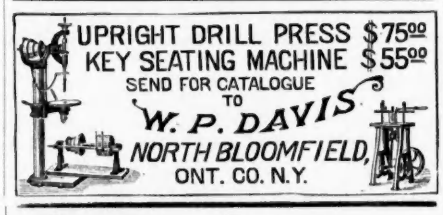

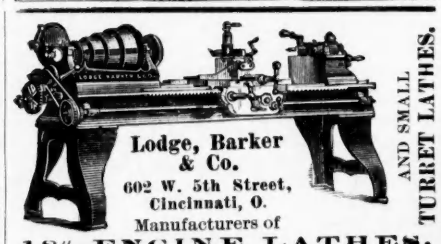

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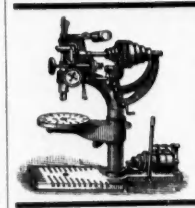

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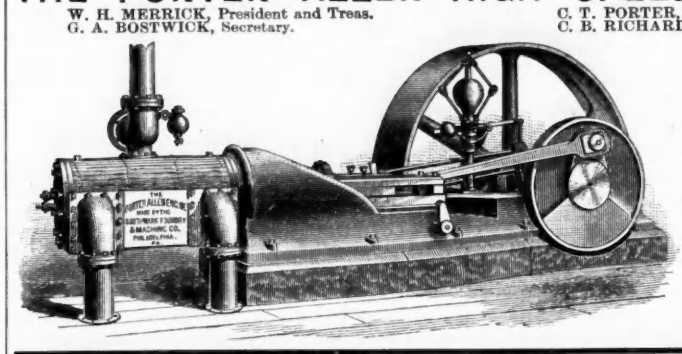

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Orders solicited for Iron and Brass Castings in the rough.

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Designed for use in Gold, Silver, Coal and Iron Mines. Also for general Manufacturing and Fire purposes.

Pumps furnished with movable linings in iron, composition or Phosphor Bronze.

THE A. S. CAMERON STEAM PUMP WORKS,

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The best and cheapest in the end. Send for quotations. The files speak for themselves in the following testimonials. Read them.

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TO WHOM IT MAY CONCERN: New York, May 1st, 1877.

We have used the Files made and re-cut by Messrs. WEINMANN & KEARNEY for the past three years, and we know of no better recommendation than the fact that we are still using them.

FLETCHER, HARRISON & CO.

WINCHESTER REPEATING ARMS CO.

Messrs. KEARNEY & FOOT, New York, New Haven, Conn., Nov. 1st, 1878.

Dear Sirs:—The Files you have been furnishing this Company have proved equal, if not superior, to any heretofore used. Yours truly, V. A. KING, Sup't.

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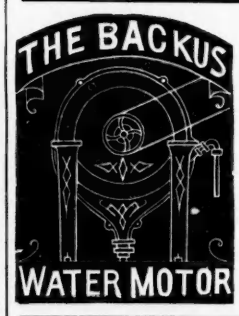

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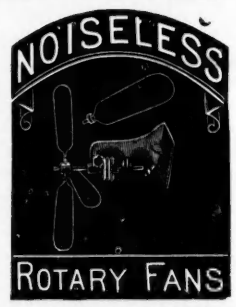

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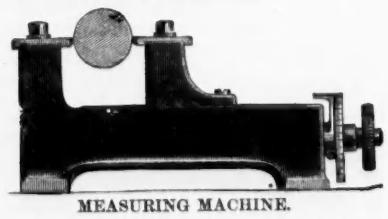

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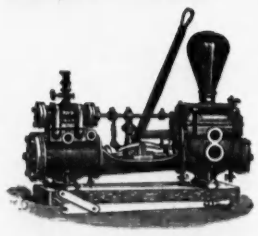

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